VOL. 6 NO. 8
April 30, 1981

Energy Research Abstracts

ABSTRACTS 10079-11871

Technical Information Center
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications which are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the energy data base of the Technical Information Center; all references are also available for machine searching via the on-line retrieval system, DOE/RECON. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below.

PUBLICATIONS OF THE TECHNICAL INFORMATION CENTER

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize the following: programmatic efforts; legislative, regulatory, and other legal aspects; social, economic, and environmental impacts; regional and sectoral analyses; institutional factors, etc. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402; domestic subscribers $3.00, foreign $3.75 per copy; annual cumulative index, domestic $4.00, foreign $5.00 per copy. The annual subscription price is $38.00 for domestic subscribers and $47.50 for foreign subscribers.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. Indexes are cumulated semiannually and annually. *ERA* is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues including a semiannual index and an annual index is $184.00 for domestic subscribers and $230.00 for foreign subscribers. The semiannual and annual indexes will also be available separately to subscribers. The cost for the semiannual index is $18.00 (domestic) or $22.50 (foreign); the annual index is $33.00 (domestic) or $41.25 (foreign). A single issue costs $5.55 (domestic) or $6.95 (foreign).

The following publications are available to the public on a subscription basis from the National Technical Information Service (NTIS), Springfield, Virginia 22161. The annual subscription rate for one volume (calendar) year (12 issues plus cumulative index) is $45.00 for domestic subscribers and $90.00 for subscribers outside the North American Continent. A single issue is $6.00 (domestic) and $12.00 (outside the North American Continent).

Current Energy Patents (CEP)

A monthly publication providing abstracting and indexing coverage of the international patent literature, including patent applications, that concerns any aspect of energy production, conservation, and utilization. Available as PB81-902800.

Energy Conservation Update (ECU)

A monthly abstract journal devoted to current information on energy conservation in buildings, transportation and propulsion, and industry; waste processing plants and equipment; energy storage; energy conversion; advanced automotive systems; combustion systems; power cycles; synthetic fuels; and power transmission. Available as PB81-914800.

Energy and the Environment (EAE)

A monthly abstract journal devoted to information on the impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment. Available as PB81-914900.

Fossil Energy Update (FEU)

A monthly abstract journal devoted to information on the processing and use of fossil fuels. Available as PB81-914600.

Fusion Energy Update (CFU)

A monthly abstract journal devoted to information on controlled thermonuclear research. Available as PB81-915300.

Geothermal Energy Update (GEU)

A monthly abstract journal devoted to information on the exploration and development of geothermal resources. Available as PB81-914700.

Solar Energy Update (SEU)

A monthly abstract journal devoted to information on the utilization of solar, tidal, and wind energy. Available as PB81-914500.

Synthetic Fuels Update (SFU)

A monthly abstract journal devoted to information on coal gasification; coal liquefaction; other coal processing; biomass conversion to fuel; shale oil and tar sand bitumen production; hydrogen fuels; other hydrocarbon fuels; alcohol fuels; and inorganic hydrogen compound fuels. Available as PB81-902700.

INTERNATIONAL ENERGY PUBLICATIONS

Atomindex (Published in cooperation with the Technical Information Center by the International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria)

A semimonthly abstract journal devoted to information on nuclear science and technology. Through an exchange agreement, IAEA/INIS provides all non-U. S. nuclear information of *Atomindex* to TIC for inclusion in the DOE/RECON Data Base; in turn, TIC provides all U. S. nuclear information to IAEA/INIS for inclusion in *Atomindex*. *Atomindex* is available by subscription from UNIPUB, P.O. Box 433, Murray Hill Station, New York, NY 10016. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $150.

Coal Abstracts (Published in cooperation with the Technical Information Center by the International Energy Agency, IEA Coal Research, London, England)

A monthly abstract journal devoted to information on coal. Through an exchange agreement, IEA Coal Research provides all non-U. S. coal information of *Coal Abstracts* to TIC for inclusion in the DOE/RECON Data Base; in turn, TIC provides all U. S. coal information to IEA Coal Research for inclusion in *Coal Abstracts*. *Coal Abstracts* is available to Department of Energy components and contractors from the Technical Information Center. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE TECHNICAL INFORMATION CENTER

The Technical Information Center, as the national information center for the Department of Energy, manages, publishes, and disseminates scientific, technical, and practical energy information acquired from worldwide sources. It builds and maintains energy information data bases used to prepare abstracting journals, bibliographies, and literature searches. The data bases are also searchable via the Department's on-line retrieval system, DOE/RECON. This information is provided to DOE program offices and contractors; scientists; engineers; educational, commercial, and industrial communities; and the general public. The Technical Information Center conducts an active announcement and marketing program. It establishes policy and administers control of an inventory and registry for DOE publications. The Center also develops and evaluates new and effective information systems and services as required by scientific and technical management within the Department of Energy.

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers, and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, conservation, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Federal, state, and municipal agencies concerned with energy development, conservation, and usage may obtain *ERA* free of charge. Inquiries should be directed to the Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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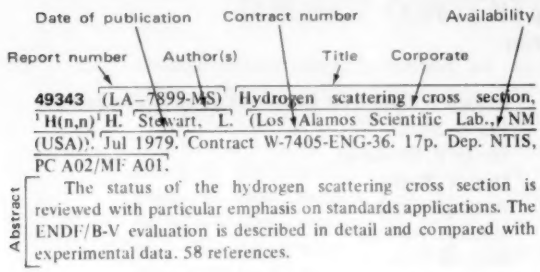
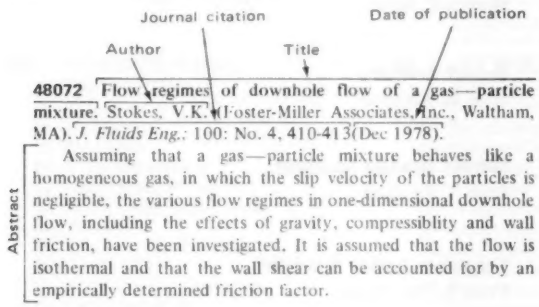
• ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Date of publication
Contract number
Availability
Report number
Author(s)
Title
Corporate
49343 (LA-7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.
Abstract
The status of the hydrogen scattering cross section is reviewed with particular emphasis on standards applications. The ENDF/B-V evaluation is described in detail and compared with experimental data. 58 references.


Journal citation
Date of publication
Author
Title
48072 Flow regimes of downhole flow of a gas—particle mixture. Stokes, V.K. (Foster-Miller Associates, Inc., Waltham, MA). J. Fluids Eng.: 100: No. 4, 410-413 (Dec 1978).
Abstract
Assuming that a gas—particle mixture behaves like a homogeneous gas, in which the slip velocity of the particles is negligible, the various flow regimes in one-dimensional downhole flow, including the effects of gravity, compressibility and wall friction, have been investigated. It is assumed that the flow is isothermal and that the wall shear can be accounted for by an empirically determined friction factor.

• INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. These indexes are cumulated semiannually and annually. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

49343 (LA-7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

is indexed as:

Los Alamos Scientific Lab., NM (USA)
Advanced laser fusion target fabrication research and development proposal, 4:48249 (LA-7619-P)
Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA-7899-MS)

• Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Stewart, L., Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA-7899-MS)
Stewart, M.D., *See* McInroy, J.F., 4:49280
Stewart, W., *See* Dean, J.W., 4:48543
Stimson, J., Reproduction, growth, and survival of Enewetak corals, 4:49200 (NVO-0703-1, pp 56-59)

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles and informative phrases, or both, specific to these entries are arranged alphabetically under the entries.

HYDROGEN I TARGET
Neutron Reactions
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HYDROGEN NITRATES
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Inventory of advanced energy technologies and energy conservation research and development: 1976-1978. Volume II. Prepared for the Committee on Science and Technology, U.S. House of Representatives, 96*th* Congress, 4:48749.

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36	**Los Alamos Scientific Lab., NM (USA)**	
	3:49698	LA-tr-78-45
	3:49857	LA-7224T
	3:49863	LA-7235-MS
W-7405-ENG-48	**California Univ., Livermore (USA). Lawrence Livermore Lab.**	
	3:49386	UCRL-52456
	3:49431	UCRL-52405

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience.

LA-		
7899-MS	4:49343	Dep. NTIS, PC A02/MF A01
LA-tr-		
78-69	4:48158	Dep. NTIS, PC A03/MF A01

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SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 294 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope notes is available as DOE/TIC-4584-R4 from NTIS for $7.00.

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SUBJECT CONTENTS (ALPHABETICAL LISTING)

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 11059

10079 (ORNL/TM—7635) Fossil energy program progress report for November 1980. McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-26. 118p. NTIS, PC A06/MF A01.

This report - the seventy-sixth of a series - is a compendium of monthly progress reports for the ORNL research and development programs that are in support of the increased utilization of coal and other fossil fuel alternatives as sources of clean energy. The projects reported this month include those for coal conversion development, chemical research and development, materials technology, component development and process evaluation studies, technical support to major liquefaction projects, process analysis and engineering evaluations, fossil energy environmental analysis, flue gas desulfurization, solid waste disposal, coal preparation waste utilization, plant control development, atmospheric fluidized bed coal combustor for cogeneration, TVA FBC demonstration plant program technical support, PFBC systems analysis, fossil fuel applications assessments, performance assurance system support for fossil energy projects, international energy technology assessment, and general equilibrium models of liquid and gaseous fuel supplies.

0104 Processing

REFER ALSO TO CITATION(S) 10161, 10170, 10173, 10178, 10180, 10182, 10183, 10184, 10206, 10222, 10228, 10229, 10231, 10265, 10411, 11061, 11135, 11191, 11272, 11529, 11559

10080 (ANL-FE—49622-TM09) Monitoring temperatures in coal conversion and combustion processes via ultrasound. Gopalsami, N.; Raptis, A.C.; Mulcahey, T.P. (Argonne National Lab., IL (USA)). Feb 1980. Contract W-31-109-ENG-38. 48p. NTIS, PC A03/MF A01.

A study of the state-of-the-art of instrumentation for monitoring temperatures in coal conversion and combustion systems has been carried out. The instrumentation types studied include Thermocouples, Radiation Pyrometers, and Acoustical Thermometers. The capabilities and limitations of each type are reviewed. The study determined that ultrasonic thermometry has the potential of providing viable instrumentation. Consequently, a feasibility study of the ultrasonic thermometry was undertaken. A mathematical model of a pulse-echo ultrasonic temperature measurement system is developed using linear system theory. The mathematical model lends itself to the adaptation of generalized correlation techniques for the estimation of propagation delays. Computer simulations are made to test the efficacy of the signal processing techniques for noise-free as well as noisy signals. Based on the theoretical study, acoustic techniques to measure temperature in reactors and combustors are feasible. To experimentally verify the technique it is needed (a) to test the available sensor materials at high temperatures under erosive and corrosive conditions and (b) upon the selection of the appropriate sensor material to validate the proposed signal processing technique. The base for the applicability of this technique will be the frequency of operation, which will determine the length of the sensor and the noise background at the frequency of interest. It is, however, believed that the proposed technique will provide reliable estimates under the noise background.

10081 (BNL—51293) Flash hydropyrolysis of coal. Quarterly report No. 12, January 1-March 31, 1980. Steinberg, M.; Fallon, P.; Bhatt, B.L. (Brookhaven National Lab., Upton, NY (USA)). Aug 1980. Contract AC02-76CH00016. 27p. NTIS, PC A03/MF A01.

A number of experiments were conducted using both Pittsburgh No. 8 and Illinois No. 6 bituminous coals. Diluents of limestone, sand, CaO and K_2CO_3 were used to prevent agglomeration. No significant effect on product yield was observed for the various diluents. The Pittsburgh No. 8 gave greater yields of gaseous hydrocarbons when used at 1000 psi and 950°C than at the same pressure at 900°C. Similar experiments with New Mexico sub-bituminous coal both treated with Na_2CO_3 and untreated did not produce any increase in yields. The Pittsburgh No. 8 coal also yielded 15% BTX when used at 1000 psi and 820°C. The Illinois No. 6 coal showed no effect of pressure on yield when hydrogenated at 775°C and increasing pressures of 1000, 1500 and 2000 psi of hydrogen. The yield of gas ranged from 15 to 21% and the liquids from 9 to 14%. A first recycle of Illinois No. 6 char showed some remaining reactivity increasing the gaseous yield from 43 to 51% and the liquid yield from 9 to 10%. A second recycle produced only a 1% increase in the gas yield. The introduction of 20% steam into the hydrogen at 1000 psi and 900°C using New Mexico sub-bituminous coal increased the liquid yield from 7 to 10% but lowered the gaseous yield from 46 to 42%. A significantly greater fraction of naphthalene was found in the heavy liquids from the bituminous coals than from the lignite and sub-bituminous coal (72 vs 50%).

10082 (CONF-800334—(Vol.1), pp 55-65) Coal desulfurization: application of basic research in sulfur chemistry to process research and development. Squires, T.G.; Chang, L.W.; Venier, C.G.; Barton, T.J. (Ames Lab., IA). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

There are basically three kinds of desulfurization techniques: physical methods such as crushing and gravity separation; physicochemical treatments such as chemical comminution and froth flotation; and chemical processes such as oxidative leaching. This paper will focus on the contributions of Ames Laboratory to the development of the latter techniques. The ultimate objective of the effort is to discover a highly efficient, low cost process for desulfurizing large quantities of coal. Studies of the basic chemistry of organic sulfur compounds under process conditions is a valuable tool for process evaluation and improvement. Our studies show that the alkaline leaching of coal under air pressure rapidly removes pyritic sulfur, but is likely to affect only one particular functional type of organic sulfur compound. Moreover, conditions severe enough to oxidize additional classes of organic sulfur compounds will likely oxidize the carbon-hydrogen structure of coal and significantly decrease heating value. New chemistry on each of the two steps of oxydesulfurization, (1) oxidation and (2) desulfonylation, has been found. Catalytic formation of organic hydroperoxides under process conditions gives a new oxidant which allows organic sulfur to be oxidized selectively. By use of phase-transfer reagents, the reaction of dibenzothiophene sulfone with potassium hydroxide can be accomplished at temperatures lower than those observed by previous workers. A new intermediate product was discovered. Exploitation of its chemistry may allow the development of milder conditions for dibenzothiophene desulfurization. Basic studies of the chemistry of other desulfurization methods should be equally successful. Each advance in fundamental knowledge of the chemistry of underlying processes will allow the systematic development of improved methods.

10083 (CONF-800334—(Vol.1), pp 67-79) Sulfur and ash reduction in coal by magnetic separation. Hise, E.C. (Oak Ridge National Lab., TN). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The magnetic preparation of dry crushed coal is discussed in the context of its potential role as one of the unit operations in the

overall coal preparation process. Physical coal preparation in general is discussed. The economics of dry vs wet preparation of coal are discussed. High-gradient magnetic separation of coal depends on the fact that the iron pyrite and many other inorganic contaminants in coal are weakly paramagnetic. A large number of batch separation tests on several coals have been performed. Good separations have been obtained on the coals and size fractions tested with removal of essentially all liberated pyrite at a Btu recovery of 95%. A continuous separation machine has been set up to test continuous separation at a 1 ton/h feed rate. These separations compare favorably with the batch tests. The development of one or both of the above methods for commercial use is underway. (DMC)

10084 **(DOE/ET/10143—T1) H-coal pilot plant. Phase II. Construction. Phase III. Operation. Annual report No. 3.** (Ashland Synthetic Fuels, Inc., KY (USA)). 4 Feb 1981. Contract AC05-76ET10143. 26p. NTIS, PC A03/MF A01.

At the request of DOE Oak Ridge, ASFI agreed to assume responsibility for completion of Plant construction in December, 1979, at which time Badger Plants' on-site work was ended. This construction effort consisted of electric heat tracing and insulation of piping and instrumentation. At the close of the reporting period the work was completed, or was projected to be completed, within the ASFI budgeted amounts and by dates that will not impact Plant operations. Engineering design solutions were completed for problems encountered with such equipment as the High Pressure Letdown Valves; Slurry Block Valves; Slurry Pumps; the Bowl Mill System; the Dowtherm System; and the Ebullating Pump. A Corrosion Monitoring Program was established. With the exception of Area 500, the Antisolvent Deashing Unit, all operating units were commissioned and operated during the reporting period. Coal was first introduced into the Plant on May 29, 1980, with coal operations continuing periodically through September 30, 1980. The longest continuous coal run was 119 hours. A total of 677 tons of Kentucky No. 11 Coal were processed during the reporting period. The problems encountered were mechanical, not process, in nature. Various Environmental and Health programs were implemented to assure worker safety and protection and to obtain data from Plant operations for scientific analysis. These comprehensive programs will contribute greatly in determining the acceptability of long term H-Coal Plant operations.

10085 (DOE/ET/10527—T1, pp 3-14) **Catalytic gasification of coal to high-Btu gas.** Sep 1980.

In Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Final report.

Technologies for the conversion of coal to high-Btu gas are usually initiated by reacting the coal with steam and oxygen in the temperature range of 950°C or higher. Direct reaction of coal with steam is practiced because water must ultimately be the primary source of hydrogen for such processes. The steam-coal reaction is highly endothermic and requires temperatures of the order of 950°C or higher if the reaction is to proceed at a reasonable rate without an externally applied catalyst. The molecular oxygen is introduced to react with carbon in the coal to produce the energy necessary to achieve and maintain the temperature for the reaction. The carbon monoxide thus produced from the oxygen and from the steam is to be hydrogenated to produce principally methane. The ratio of hydrogen to carbon monoxide must be greatly increased to accomplish this. Thermodynamic considerations demand that the reaction of carbon monoxide and more steam to produce molecular hydrogen must be conducted at temperatures of 450°C or lower, if a hydrogen-carbon monoxide ratio of 3 or greater is to be achieved. This reaction must proceed with the help of a catalyst. As much as 1/3 of the heating value of the coal, or perhaps more, is lost to the process through this sequence of events. It has been noted, however, that the overall process of converting coal to methane approaches thermal neutrality if the entire process could be achieved at temperatures in the range of the methanation reaction. Experiments to test this possibility are described: procedure, conditions, catalysts, yields, etc. are given. (LTN)

10086 (DOE/ET/10527—T1, pp 15-31) **Dissolution of coal in hydrogen donor solvents with application of catalysts and energized conditions to produce clean fuels.** Sep 1980.

In Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Final report.

The purpose of this investigation was to elucidate fundamental structural features of coal by means of chemical characterization of coal-derived liquids (CDL). A new characterization scheme was devised based on available information on coal and CDL. Three CDL from a high volatile bituminous (hvb) coal were prepared in two high-conversion processes, and characterized according to the new scheme. Major findings from the three CDL are as follows: 1) A CDL (HVL-P) produced by hydrogenation at 500°C with several seconds of residence time and zinc chloride as catalyst was almost completely depolymerized, that is, the number of ring systems per molecule was reduced essentially to one. These materials apparently were derived from three or four different structural units in coal. 2) A solubilization product (SP-300) obtained in a reaction with NaOH/ethanol at 300°C, was much less depolymerized than HVL-P, but the average size of its aromatic clusters was almost the same 2.2 aromatic rings per cluster, as that of HVL-P. This agreement indicated that the average size of aromatic clusters in the hvb coal was about 2.2. Certain other results are presented. The findings support the current qualitative understanding that coal is a heterogeneous, polymer-like material consisting of aromatic clusters. The present results revealed the heterogeneity, polymeric nature and aromatic clusters of coal more quantitatively. The new characterization scheme and the procedure for determining structural parameters seem to be a practical way of improving our understanding of some of the structural features of coal.

10087 (DOE/ET/10527—T1, pp 32-45) **Dissolution of coal in hydrogen donor solvents with application of catalysts and energized conditions to produce clean fuels.** Sep 1980.

In Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Final report.

These conclusions are based on the study of Hiawatha, Utah and Kentucky No. 14 coals; however, some conclusions may be applicable to other coals of similar rank and origin: 1) The average basic skeletal unit in the bituminous coal structure is composed of 3 to 4 ring clusters. 2) Ether bonds and short hydrocarbon chains (C_1-C_3) are labile linkages in the dissolution process, but ethers constitute the major species. 3) Ether, phenol and carbonyl may have some interaction during the dissolution process, and the hydrogenolysis of phenol is the limiting step for the removal of oxygen atoms. 4) Even similar bituminous coals show significant differences in reactivity and product distribution under the same dissolution treatment. 5) Some carbonyls in the primary extracts and probably in the coals are aldehyde type. 6) During the initial reaction period, hydrogen supplied to the extraction products comes preferentially from coal (intra H-transfer at the expense of aliphatic (alkyl and naphthenic). Significant changes also take place in the functionality of the soluble products. 7) Long-term reaction results in net loss of extract due to the formation of light end products (oil and gas). Significant H-transfer takes place from the solvent to the total extraction products. 8) Higher conversion temperatures promote utilization of the coal-derived hydrogen which is accompanied by increased aromaticity of the extraction products.

10088 (DOE/ET/10527—T1, pp 46-48) **Dissolution of coal in hydrogen donor solvents with application of catalysts and energized conditions to produce clean fuels: extraction under mild conditions.** Sep 1980.

In Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Final report.

Extracts produced from the coals under mild conditions were markedly different in physical appearance depending on the coal and the solvent used. Benzene extracts were different both in amount and character from the different coals. High volatile bituminous Utah coal extracts in general contained more paraffinic material (alkanes) and a diversity of carbonyl-type compounds. As representative information on coal extracts, Figure 1 gives results of a series displacement index for spectra of liquids produced from Hiawatha (Utah) coal. Similar information from Clear Creek (Utah) coal and CMR and PMR data gave aromaticity = fa = 0.21 and indicated the presence of long chain alkyl groups, with an average chain length of 30 to 35 carbon atoms, in benzene extracts. Pyridine was also used to extract the coals treated previously with benzene. While pyridine could extract a larger portion of the coal and the benzene soluble portion of the pyridine extract was larger than the

benzene extract, the composition of the benzene soluble portions in both cases were essentially identical. This indicates that benzene could not extract all of the benzene soluble material in the coal. Pyridine swells the coal and allows the removal of trapped material in the coal. Examination of the extracts from coal at mild conditions by infrared spectroscopy was made and results confirmed previous observations.

10089 (DOE/ET/10527—T1, pp 49-64) **Steam reforming of aromatic compounds.** Sep 1980.

In Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Final report.

The results obtained from this study of the steam reforming of aromatic compounds indicate the following: 1. Thermodynamic results suggest that the steam reforming of aromatic compounds can be carried out with slightly higher minimum steam ratios compared with that for methane and naphtha. 2. The most active catalyst, which requires a minimum steam ratio for the steam reforming of aromatic compounds, is the sodium promoted nickel catalyst. 3. The rate of reaction of benzene and steam over the above-mentioned catalyst is first order with respect to benzene and zero order with respect to steam, with an activation energy of 38.35 Kcal/mole, and the frequency factor is temperature dependent. 4. The primary products from the steam reaction are hydrogen and carbon dioxide. 5. The rate of dealkylation of alkyl-benzenes is faster than the rate of ring breakdown. 6. Isomerization and polymerization do not take place. 7. The rate of dealkylation decreases with increased temperature and pressure. 8. The dehydrogenation of higher alkyl benzenes increases with increased temperature and decreases with the increased pressure. 9. The reaction rate of alkyl benzenes decreases with the number of carbons in the side chain. 10. The reactivity of aromatic ring compounds decreases as the number of rings in the compound increases. 11. A fuel gas of medium heating value (up to 650 Btu/SCF) gas can be produced directly by steam reforming of aromatics.

10090 (DOE/ET/10527—T1, pp 65-85) **Study of thermal and vapor phase catalytic upgrading of coal liquids.** Sep 1980.

In Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Final report.

The following conclusions were reached on the basis of results obtained: (1) Hydrotreated SRC II liquids and structurally related polycyclic naphthenes and naphthenoaromatics undergo smooth catalytic cracking under mild temperature conditions (325 to 425°C) to yield predominantly light liquid products, with little concurrent gasification and very low coke formation. (2) The composition of liquid products from catalytic cracking of hydro-SRC II and related polycyclic naphthenes is easily controllable, and by appropriate coordination of operating variables, gasoline-range products containing high concentrations of isoparaffins, C_5-C_{12} naphthenes and C_6-C_{12} benzenes can be obtained. The great potential of the newly developed, large-pore cross-linked smectite (CLS) catalysts for cracking of heavy feedstocks was demonstrated in comparative cracking studies with bulky (kinetic diameter $\geqq$ 11 A) polycyclic napthenes and naphthenoaromatics.

10091 (DOE/ET/10527—T1, pp 86-110) **Synthesis of light hydrocarbons from H_2 and CO.** Sep 1980.

In Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Final report.

The objectives of this project were to screen a significant number of promoted and unpromoted mono- and multimetallic catalysts containing iron, cobalt and nickel for the hydrogenation of carbon monoxide to produce low molecular weight olefins. The more active and/or selective catalysts would later be subjected to extended process variable studies. The catalyst evaluation parameters, temperature, pressure and H_2/CO ratio were determined by the activity and selectivity exhibited by the catalysts whereas the space velocity, 3000 to 5000 GHSV, was limited to the range of values typical of commercial operations of similar or related conversion processes. The data developed in these investigations are discussed under three headings; that is, the catalysts screening experiments, the copper-cobalt catalyst system investigation and the iron-manganese catalyst process variable investigation.

10092 (DOE/ET/10527—T1, pp 111-128) **Synthesis of light hydrocarbons from CO and H_2 (continued): catalyst characterization studies.** Sep 1980.

In Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Final report.

This phase of the project is intended to supplement the high pressure reactor studies by detailed examination of the catalyst properties which enhance catalyst activity and selectivity. This is accomplished by characterization studies performed on the same catalysts which have been run in the high pressure reactor. Of particular interest are metal areas, evidence of alloy formation, phase structures and catalyst stability. Also, variables in catalyst preparation and pretreatment are examined to establish effects on catalyst properties. Finally, characterization results are compared with catalyst activities to obtain correlating relationships. It was concluded that: 1. Catalyst activity for CO conversion depends upon total metal surface area as determined by 0_2 adsorption. 2. Catalyst selectivity for C_2-C_4 products appears to be related to a Co-rich, CoCu alloy surface phase, which is maximum at a reduced Cu mole fraction of about 0.8. 3. Catalyst selectivity for C_5^+ products appears to be related to a CoCu alloy surface phase of intermediate composition, showing a maximum around 0.3 reduced Cu mole fraction.

10093 (DOE/ET/10527—T1, pp 129-143) **Development of optimum catalysts and supports.** Sep 1980.

In Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Final report.

This project involves assessing diffusional resistances within amorphous-type catalysts. Of primary concern is the question of whether the larger, multiringed aromatics found in coal-derived liquids will have adequate accessibility to the active sites of typical processing catalysts. When molecular dimensions approach pore size diameters, the effectiveness of a particular catalyst is reduced owing to significant mass transport resistance. An extreme case occurs when molecular and pore sizes are equivalent, and pores below this size are catalytically inactive. The project objective was achieved through a systematic study of the effect of molecular size on sorptive diffusion rates relative to pore geometry. Five commercially available aromatic compounds were used in this study. Their properties are presented in Table 1. These studies of diffusion of condensed, multiring aromatic compounds into porous aluminas showed the following: 1) Adsorption increased with molecular size and followed a Langmuir adsorption isotherm. 2) Rate of diffusion decreased with molecular size. 3) Measured diffusivities were faster than predicted for simple pore diffusion and a surface contribution was postulated. 4) Surface diffusivities decreased with molecular size, but the fraction due to surface diffusion remained approximately constant. 5) Restricted diffusion was detected only with the largest solute and smallest pore alumina studied.

10094 (DOE/ET/10527—T1, pp 144-161) **Effects of poisoning on the desulfurization activity of cobalt-molybdate catalysts.** Sep 1980.

In Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Final report.

To gain an insight into the deactivation mechanism with coal-derived feedstocks, the detailed kinetics of benzothiophene hydrodesulfurization have been compared before and after addition of various poisons and coke precursors. The studies were carried out using a constant stirred microbalance reactor, which enables simultaneous measurement of catalyst weight and change of activity. Supplementary studies were made to gain additional insight into the affect of poisons on the active catalyst sites. 1) The original stirred, microbalance reactor for gasphase feeds was inadequate for liquid feeds. After modifications, the reactor exhibited excellent performance with a model test reaction. 2) A catalyst poisoning technique was developed to measure the number of active sites on the catalyst under steady-state conditions. 3) Hydrodesulfurization of benzothiophene increased with temperature and H_2 pressure, but decreased with benzothiophene and H_2S pressure. 4) Equilibrium adsorption data for H_2S over the sulfided catalysts followed a Langmuir isotherm. Poisoning reduced the amount of H_2S adsorbed. 5) Temperature programmed desorption of thiophene in He showed a complex pattern, including desorption of thiophene from several different sites and decomposition to butene and H_2S. Poisoning affected the desorption process in a complicated matter. 6) The state of the sulfided catalyst changes after reaction with thiophene for an

extended period. Thiophene is active in removing residual amounts of oxygen left on the sulfided catalyst.

10095 (DOE/ET/10527—T1, pp 162-183) **Fundamental studies on hydrogen transfer over coal conversion catalysts.** Sep 1980.

In Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Final report.

The exchange between the deuterated solid phosphoric acid (SPA) surface and an olefin indicates that the SPA surface acts as a proton donor to the olefin, forming a carbonium ion as indicated. However, even though carbonium ions were formed, they did not extract hydride ions from tertiary positions of paraffins. The exchange reactions over silica-alumina were consistent with the view that both Lewis and Bronsted sites are present on the surface. With gamma-alumina, surface deuterium exchanged with the hydrogen of paraffins with no olefin present, indicating that Lewis acid sites or possibly base sites capable of polarizing the molecule were present. The results of the exchange reactions using zinc chloride, indicate that hydrated zinc chloride behaved solely as a Bronsted type acid. Carbonium ions were formed from olefins with both the zinc chloride and the solid phosphoric acid catalysts, but in both cases the carbonium ions did not abstract hydride ions as expected. Results of the exchange reactions using coal indicate that the zinc chloride/coal combination also behaves as a Bronsted acid. Furthermore, untreated coal exhibits a weak Bronsted activity. The observations support the view suggested by Massoth that the presence of zinc chloride does not provide new reaction pathways to hydrogen transfer, but rather it enhances pathways which were already available to untreated coal.

10096 (DOE/ET/10527—T1, pp 184-203) **Mechanism of catalytic hydrogenation by metal halide catalysts.** Sep 1980.

In Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Final report.

The mechanism of catalytic hydrogenation of coal by metal halide catalysts was further studied in this investigation. The products of hydrogenation reactions were analyzed to provide information on how changes in the catalyst effected the yield and nature of the products. The heavy liquid was separated and the subfractions have been characterized by analytical procedures to determine the average chemical structure of the constituent molecules. The heavy liquids are composed of molecules of condensed-ring aromatic systems with naphthenic, aliphatic and phenolic substitution. One or more of the condensed-ring aromatic systems form a molecule. The number of rings and the relative amounts of aliphatic and aromatic carbons vary significantly with the subfractions. High molecular weight molecules generally contain long aliphatic groups. These basic structural units are also observed in solvent-refined coals and in Synthoil products. The structure of coal is thought to be similar to that of the hydrogenation products, but the same basic structural units are highly crosslinked to form a solid material. The hydrogenation process involves rupture of these crosslinks to produce lower molecular weight products. As the size is decreased the fragments became more soluble in conventional solvents used to determine conversion. The carbon backbone structure of the units is thought to be little effected by hydrogenation, although more reactive functional groups may react.

10097 (DOE/ET/10527—T1, pp 204-216) **Mechanism of pyrolysis of bituminous coal.** Sep 1980.

In Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Final report.

The compound 9-benzyl 1,2,3,4-tetrahydrocarbazole (9-BTHC) was chosen as a model compound to represent types of structural configurations and connecting bridges believed to be present in bituminous coal. It was pyrolyzed isothermally at 376 to 436°C. The products of pyrolysis were analyzed through a GC-MS for product confirmation and GC for quantitative analysis. Carbazole, 1,2,3,4-tetrahydrocarbazole, toluene and 9-benzyl carbazole were observed to be the important products of pyrolysis. Small amounts of bibenzyl were observed whereas no benzene or biphenyl was detected. The kinetic study indicated that the data fit better for second order than for first order. Furthermore, the stabilization of radicals formed by thermal rupture is effected principally by hydrogen abstraction from a second molecule. These observations indicate that the pyrolysis of the model compound 9-benzyl, 1,2,3,4-tetrahydrocarbazole is second order under isothermal conditions with radical stabilization as the rate-determining step. Inasmuch as this model compound has been chosen to represent the structures and linkage believed to exist in bituminous coal, one might infer that the pyrolysis of bituminous coal is second order under isothermal conditions.

10098 (DOE/ET/10527—T1, pp 237-257) **Coal particle and catalyst characteristics for hydrogenation evaluation and testing.** Sep 1980.

In Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Final report.

The data lead to a chemical mechanism of coal pyrolysis-hydrogenation which incorporates the following ideas: 1) the addition of molecular hydrogen without catalyst is very slow at temperatures below 600°C, 2) the hydrogenation reaction is very rapid with $ZnCl_2$ added as a catalyst to the coal, 3) the $ZnCl_2$ hydrogen complex provides an alternative source of hydrogen to the hydroaromatic hydrogen already available in the coal, 4) thermally produced free radicals in the coal are stabilized by addition of hydrogen (catalytically or from the hydroaromatic) or by the recombination of two free radicals and 5) addition of hydrogen tends to produce liquids and gases whereas the recombination of two free radicals tends to produce solids.

10099 (DOE/ET/10527—T1, pp 272-285) **Separation and characterization of coal-derived liquids.** Sep 1980.

In Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Final report.

A method has been developed to isolate a neutral, light hydrocarbon fraction from crude coal liquids. The bromine numbers of five light hydrocarbon rough cuts were determined, and indicated that the respective rough cuts contained an average of thirteen to twenty-four carbon atoms per double bond. The results of a number of fractionations indicate that precision SB distillation of light hydrocarbon rough cuts boiling up to 150°C (atm press) does not give distillates consisting of pure compounds, but does effectively cut the pot charges into much less complex fractions. Using precision SB distillation in combination with PGC, the components in an 80 to 100°C (atm press) coal liquid rough cut have been separated and isolated, and compounds representing about 70 volume % of the fraction have been spectroscopically identified (MS, IR, NMR). This method of separation, isolation and identification is very time consuming, however, and has largely been superceded by GC-MS. In some cases, the SB-PGC procedure is both useful and necessary, e.g., when, as is frequently the case with GC-MS, a particular compound can be identified by empirical formula but not by the specific isomer. (This happens if a compound is a relatively rare isomer, and known reference compounds or reference spectra are not available for comparison). In such an instance, the specific isomer can often be identified from its NMR spectrum, and it is not only useful, but mandatory that a finite sample of the compound be isolated for the NMR study. A method of characterizing the light hydrocarbons (boiling range: rm temp - 80°C) in a coal liquid has been developed and applied to the analysis of the light hydrocarbons produced in the hydrogenation of five different Utah coals (University of Utah coal hydrogenation reactor).

10100 (DOE/ET/10527—T1, pp 286-293) **Pyrolysis-gas chromatography study of coals and related model compounds.** Sep 1980.

In Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Final report.

The zinc chloride catalyzed decomposition of 1,2-DHN at 165°C occurs by a mechanism in which zinc chloride abstracts a hydrozyl ion from water and frees a proton which is donated to the double bond of 1,2-DHN to form a carbonium ion. The carbonium ion adds to the double bond of a second molecule of 1,2-DHN to yield a dimer ion from which two different dimers are produced. To a lesser extent, the initially formed carbonium ion abstracts hydride from 1,2-DHN to give tetralin, while the 1,2-DHN molecule that donates the hydride loses a proton and becomes naphthalene. The thermal decomposition of 1,2-DHN (380 to 420°C) follows simultaneous first and second order kinetics, which is consistent with the mechanism given in the report. Rate constants and activation energies for the system have been obtained, but some refinements of the data are necessary, and the k and E/sub z/ values are therefore subject to revision.

10101 (DOE/ET/10527—T1, pp 294-310) **Hydrodesulfurization of heavy hydrocarbon liquids in a fluidized bed reactor with hydrogen as the continuous phase.** Sep 1980.

In Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Final report.

Fluidized bed operation has several advantages over the conventional fixed bed operation with respect to many catalytic reactions of industrial importance. In this study, an effort has been made to determine the feasibility of vapor-phase, fluidized-bed hydrodesulfurization of a potential commercial feedstock obtained from coal (SRC-II liquid), over a commercial cobalt-molybdenum on alumina catalyst. Through experiments and theoretical analysis the following conclusions can be drawn: 1. It was possible to vaporize the heavy gas oil (280 to 389°C) completely using a hydrogen/oil feed ratio of 4000 std. cc/cc oil at 1500 psig and 400°C. The Solvent Refined Coal liquid (200 to 509°C) could be vaporized completely using a hydrogen/oil feed ratio of 5000 std. cc/cc oil at 1000 psig and 400°C or 1500 psig and 425°C. These operating conditions are in a suitable range for commercial application. 2. The Solvent Refined Coal liquid feedstocks allowed smooth and stable operation of the fluidized bed without agglomeration of the catalyst particles in the operating range studied in this work. Data on material balance indicated that all of the reaction products went overhead into the product recovery units. 3. Extensive sulfur removal was obtained in the operating range studied. This sulfur removal is increased with increasing temperature and pressure and decreased with increased space velocity. 4. The comparison of the extent of sulfur removal in fluidized, fixed and completely stirred reactor showed the fluid-bed conversion was less than that calculated for the corresponding piston-flow reactor but higher than that calculated for CSTR.

10102 **(DOE/ET/13031—T1) Pipeline gas demonstration plant, Phase I. Quarterly technical progress report for September 1980-November 1980.** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). Dec 1980. Contract AC01-77ET13031. 54p. NTIS, PC A04/MF A01.

Work was performed in the following tasks in Phase I of the Pipeline Gas Demonstration Plant Program: Site Evaluation and Selection; Demonstration Plant Environmental Analysis; Feedstock Plans, Licenses, Permits and Easements; Demonstration Plant Definitive Design; Construction Planning; Economic Reassessment; Technical Support; Long Lead Procurement List; and Project Management. The Preliminary Construction Schedule was delivered to the Government on October 3, 1980, constituting an early delivery of the construction schedule called for in the scope of work for Task VI. The major work activity continues to be the effort in Task VI, Demonstration Plant Definitive Design, with two 30% Design Review meetings being held with the Government. Work in Task VII, Construction Planning, was initiated. Work has progressed satisfactorily in the other tasks in support of the Demonstration Plant Program. A Cost Change Proposal was submitted because of an increase in the scope of work and an extension of the schedule for Phase I to 47 months.

10103 **(DOE/ET/13031—T2) Pipeline gas demonstration plant, Phase I. Quarterly technical progress report for June 1980-August 1980.** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). Sep 1980. Contract AC01-77ET13031. 54p. NTIS, PC A04/MF A01.

Work was performed in the following tasks in Phase I of the Pipeline Gas Demonstration Plant Program: Demonstration Plant Process Design; Site Evaluation and Selection; Demonstration Plant Environmental Analysis; Feedstock Plans, Licenses, Permits and Easements; Demonstration Plant Definitive Design; Economic Reassessment; Technical Support; Long Lead Procurement List; and Project Management. The following Major Contract Deliverables were submitted to the Government: Process Evaluation Report - TIC Version; Conceptual Commercial Plant Design Report - TIC Version; Demonstration Plant Design Analysis Report - TIC Version; Demonstration Plant Process Design Report; Site Master Plan; and Prevention of Significant Deterioration Documentation. The major work activity has been the effort in Demonstration Plant Definitive Design which commenced following the completion of the Process Design Baseline Packages for the fourteen Demonstration Plant process areas. Task VIII, Economic Reassessment was opened in this quarter. Completion of the TIC copies of the ICGG major deliverables constituted a significant effort in this period. Work has progressed satisfactorily in the other Tasks in support of the Demonstration Plant Program.

10104 **(DOE/ET/13046—T73) Quality Assurance/Quality Control Program Manual.** (Memphis Light, Gas and Water Div., TN (USA)). 13 Oct 1980. Contract AC02-77ET13046. 242p. NTIS, PC A11/MF A01.

The Quality Assurance/Quality Control Program in effect for Foster Wheeler is documented in three parts: Part I, The Quality Assurance Manual; Part II, The Quality Control Manual; and Part III, Client Quality Assurance/Quality Control Contract Documents. Part I, The Quality Assurance Manual, describes and summarizes the FW Quality Assurance Program applicable to FW in its function as an Engineering Contractor; Part II, The Quality Control Manual, specifies the detailed FW procedures (Job Specifications and Engineering Standards) used to implement the Quality Assurance Program delineated in Part I of this Manual. These procedures, though issued under separate cover, form, and are an integral part of, the Quality Assurance/Quality Control Program and of this Manual. These procedures are implemented in the same manner as if they were contained herein; and Part III, Client Quality Assurance/Quality Control Contract Documents, contains client QA/QC documents which are applicable to a specific contract; the specified requirements of which are incorporated and delineated in Part I and Part II of the Manual as they apply to FW.

10105 **(DOE/ET/13650—2) Review of the ORNL engineering evaluation of IITRI Project on Design, Engineering, and Evaluation of Refractory Liners for Slagging Gasifiers.** Hurley, T. (Meyer (A.F.) and Associates, Inc., McLean, VA (USA)). Jan 1981. Contract AM01-80ET13650. 8p. NTIS, PC A02/MF A01.

This report is a brief review of the ORNL Engineering Evaluation of IITRI Project on Design, Engineering and Evaluation of Refractory Liners for Slagging Gasifiers, and is limited to safety and hazard analysis. The major finding is that the existing project cannot provide a safe operating environment chiefly due to inadequate documentation and safety and hazard analysis.

10106 **(DOE/ET/14705—13) Bi-gas pilot plant operation. Technical progress report, 1 November-30 November 1980.** (Stearns-Roger, Inc., Denver, CO (USA)). 1980. Contract AC01-80ET14705. 39p. NTIS, PC A03/MF A01.

Test G-14A was completed; Test G-15 was initiated and also completed. During the latter part of G-14A, solids feed and pressure control remained stable but problems in the slag removal and spray drying areas limited further completion of objectives. Test G-15 also had very stable solids feed but problems with the gas washer and slag tap burner interrupted testing. Accomplishments during operation were: control of Stage I temperature with fuel gas flow; operation at reduced fuel gas rates to the A and C char burners; operation with three char burners of the new design; and collection of material balance data. The BI-GAS staged concept of gasification was developed by Bituminous Coal Research primarily to maximize the yield of methane as the coal is devolitized by the hot, hydrogen rich gas in Stage II. At present, the major developmental effort is concentrated on gasification. Current goals are to assess the viability of the process from an operating and cost standpoint, determine possible improvements, and obtain design data for a full scale plant.

10107 **(DOE/ET/14876—T1) Catalysts for upgrading coal-derived liquids. Quarterly report, October 1-December 31, 1980.** Crynes, B.L. (Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering). 14 Jan 1981. Contract AC22-79ET14876. 22p. NTIS, PC A02/MF A01.

A linear relationship represents the hydrogenation activity decay of catalysts used in four experimental runs reported previously. The weight percent hydrogen in the reactor product oils plotted against oil-catalyst contact time for experimental runs ZBB, ZBC, ZBD, and ZBE reveals a linear decay rate of 0.0083 wt% hydrogen per hour. This is one quantitative measure of catalyst activity decay. The data for the plot incorporate three different catalysts or

combinations used to process a PAMCO liquid at 1500 psig, 435C and LVHST of 2 hours. The data set covers run duration of up to 120 hours of oil-catalyst contact. An air driven hydrogen compressor was installed in the Catalyst Life Test Unit to reduce the costs associated with bottle hydrogen. Minor repairs were made on the oil feed pump. Five experimental runs were made with Shell 324 NiMo/Al catalyst using two feedstocks: (1) 40 wt% EDS/EDS raw solvent and (2) 30 wt% SRC-I creosote oil. The EDS feed oil proved to be rather easily hydrotreated as evidenced by 82 to 100% nitrogen removal, essentially complete desulfurization and no catalyst activity decay during 260 hours of continuous operation. Rapid coking resulted from the highly hydrogen deficient SRC/creosote mixture. The Shell 324 catalyst gave excellent hydrogenation of both liquids by increasing the hydrogen content of the product oils by about 3.8 wt%. This catalyst will be used in future studies; however, a new feedstock consisting of 30 wt% SRC-I/PAMCO process solvent will be assessed for use in catalyst decay mechanism studies.

10108 **(DOE/MC/11630—T1) Programmed temperature gasification study. Final report, October 1, 1979-November 30, 1980.** Spoon, M.J.; Gardner, M.P.; Starkovich, J.A.; Fein, H.L.; Apte, A.J. (TRW Systems, Redondo Beach, CA (USA)). 30 Nov 1980. Contract AC21-79MC11630. 102p. NTIS, PC A06/MF A01.

An experimental, modeling and conceptual engineering analysis study has been performed to assess the feasibility of TRW's Programmed Temperature Gasification (PTG) concept for carbonizing caking coals without severe agglomeration. The concept involves control of carbonizing heating rate to maintain metaplast concentration at a level equal to or slightly below that which causes agglomeration. The experimental studies required the contruction of a novel programmed temperature, elevated pressure, hot stage video microscope for observation of coal particle changes during heating. This system was used to develop a minimum-time heating schedule capable of carbonizing the coal at elevated pressures in the presence of hydrogen without severe agglomeration. Isothermal fixed heating rate data for a series of coals were subsequently used to calibrate and verify the mathematical model for the PTG process. These results showed good correlation between experimental data and mathematical predictions. Commercial application of the PTG concept to batch, moving bed and fluid bed processing schemes was then evaluated. Based on the calibrated model programmed temperature gasification of the coal without severe agglomeration could be carried out on a commercial batch reaction in 4 to 12 minutes. The next step in development of the PTG concept for commercial application would require testing on a bench scale (3-inch diameter) gasifier coupled with a full commercial assessment to determine size and cost of various gasification units.

10109 **(DOE/METC/14386—106) Hydrogen-methane separation processes and related phenomena.** Saunders, J.T.; Wang, S.S.; Yang, R.T. (State Univ. of New York, Buffalo (USA). Dept. of Chemical Engineering). Jan 1981. Contract AC21-80MC14386. 50p. NTIS, PC A03/MF A01.

A thorough and up-dated literature survey has been conducted on processes for separating hydrogen and methane. This was done in conjunction with our work of developing a more energy-efficient and lower-cost process based on cyclic, fixed-bed processes using coal chars as the sorbents. Although the review has covered all hydrocarbon separation processes, the focuses were on physical adsorption phenomena and theories (for both single and mixed gases), surface and pore characteristics of coals and heat-treated coals, and the continuous or semi-continuous chromatographic separation methods. There has been a sharply increasing interest in the past 10 to 15 years in developing processes for hydrocarbon separation based on adsorption/desorption; this is particularly true since the energy costs became increasingly higher recently. The rigorous work on competitive adsorption and on the cyclic (including parametric pumping) processes has all been done in the past 13 years. On the other hand, it is disappointing to find the absence of knowledge on adsorption on coal chars and the lack of it on adsorption on raw coals as well.

10110 **(DOE/METC/SP—104) Survey of materials for critical valves in coal conversion applications.** McGhee, T.A. (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). 8 Jan 1981. 187p. NTIS, PC A09/MF A01.

The development of coal conversion technology is of prime importance in the energy future of the United States. The materials from which the coal conversion system components, such as valves, are fabricated are critical in the design of the component due to the severe environment in which they must economically and reliably operate. This report represents a literature review of the present technology of wear-resistant materials available from research and industry to the designers and manufacturers of coal conversion valves. The writing of the report began with a classification of the types of valves used and the service required with respect to: Pressure, temperature, and media handled. A priority ranking of wear considerations for each type of valve was established. The valve classification was used as a base by which the initial communication of the information requirements was made to the representatives of materials companies and research institutions chosen to be possible contributors. Literature from these contributors was received and divided into three basic categories of materials: Bulk materials (including cemented carbides), coating materials, and ceramic materials. Properties of importance to valve applications for each type of material were determined. The information from each contributing company and institution was classified and summarized under each property and presented in both written and tabular form. After a review and critique by the Project Manager of the Valve Testing and Development Projects at METC, each section of the survey was mailed to its respective contributor for review concerning the technical accuracy and completeness. The reviewed sections were arranged as presented.

10111 **(DOE/OR/03054—T3) SRC-1 solvent-refined coal. Quarterly technical report, January-March 1980.** (International Coal Refining Co., Allentown, PA (USA)). 1980. Contract AC05-78OR03054. 63p. NTIS, PC A04/MF A01.

Four papers in this quarterly report have been entered individually into EDB and ERA. They deal with reducing organic solvent losses in the Kerr-McGee solvent deashing process; with the design of heaters for the process (which involved determining the temperature dependence of the enthalpy of the organic solvent, coal and hydrogen mixture); with a review of the carbon dioxide greenhouse effect on global climates; and with a methodology for fractionating and evaluating the coal liquids produced. (LTN)

10112 (DOE/OR/03054—T3, pp 1-7) **Testing the Nara Paddle Dryer to reduce deashing solvent levels.** Raman, S.V. (International Coal Refining Co., Allentown, PA). 1980.

In SRC-1 solvent-refined coal. Quarterly technical report, January-March 1980.

As a result of the unsatisfactory performance of the ash concentrate dryer at Wilsonville, high levels of deashing solvent (1 to 10 wt %) have been reported in the ash concentrate. Levels below 1 wt % are desired. In fact, specific ash handling and transport procedures may dictate that the deashing solvent be reduced to trace amounts. The Phase 0 design for the ash concentrate dryer is similar to that at Wilsonville, i.e., a flash drum with a steam stripper. Equipment modifications are under way at Wilsonville to demonstrate the operation of the flash drum-steam stripper and obtain data on the fines carryover. If, after the modificatons, the deashing solvent content is still too high, a dryer with a long residence time will be required downstream of the flash drum. In order to have this option available if the need arises, ICRC is conducting tests of drying Kerr-McGee ash concentrate from Wilsonville in such a dryer, a Nara Paddle Dryer.

10113 (DOE/OR/03054—T3, pp 8-41) **Slurry fired heater update of data base and design options.** Thorogood, R.M. (International Coal Refining Co., Allentown, PA). 1980.

In SRC-1 solvent-refined coal. Quarterly technical report, January-March 1980.

The overall furnace heat duty calculated for the Phase 0 Demonstration Plant design has been confirmed recently by measurements of coal slurry enthalpy. These data also provide a basis

for determining coal slurry enthalpy as a function of the temperature through the Slurry Fired Heater. Other studies involving the Slurry Fired Heater include an investigation of the limiting heat fluxes that are permissible for various heat transfer modes and furnace configurations. A method has also been determined for assessing thermal stress limitations on heat flux. An analysis of pressure drop data from the preheater in the Wilsonville Pilot Plant has been used to predict pressure drops in the gas-slurry flow system of the Demonstration Plant. Further development of pressure drop and heat transfer data is one objective of the SRC-1 experiments scheduled for May and June 1980 at Fort Lewis; they are described at the end of this article. Alternatives to the all-convective design for the Slurry Fired Heater recommended in the Phase 0 Report are being explored and evaluated by Catalytic, Inc., the contractor for Area 12 of the Demonstration Plant, and by specialists in furnace design. This article discusses some of the factors under consideration.

10114 (DOE/OR/03054—T3, pp 55-57) **Postscript on methodology: 8-hour separation procedure.** Schweighardt, F.K. 1980.

In SRC-1 solvent-refined coal. Quarterly technical report, January-March 1980.

In a typical liquefaction process preasphaltenes are generated in the dissolver stage with only small quantities of hydrogen consumed. Physical changes also occur: the concentration of slurry solids decreases, the viscosity increases, and some thermal effects are noticed. In the reaction zone downstream (or still in the dissolver if recycle solvent and hydrogen conditions are sufficient), asphaltenes, benzene-solubles, and pentane-insolubles increase. Depending upon residence time, pentane-soluble oils may be generated along with hydrocarbon gases. As the process stream travels along, it sees a variety of conditions, in some of which regressive reactions in which certain products revert to less soluble components. Many of these regressive reactions seem to produce pyridine-insoluble components similar to the original coal - but much less reactive. Because of the complexity of coal-derived products, some degree of separation is required in order to classify and quantify changes occurring during conversion. The separation technique used in the Corporate Laboratories of Air Products and Chemicals, Inc. (APC) isolates oils, asphaltenes, preasphaltenes, and residue in a matter of eight man-hours. The procedure applies classical coal chemistry thought to present state-of-the-art-technology. The philosophy is to define each subfraction in terms of solubility in and not as a precipitate from a particular solvent or solvent pair. The procedure is described in detail and compared with results of other methods.

10115 **(DOE/OR/20687—T2) Wear-resistant materials for coal conversion and utilization. First progress report, October 1980-December 1980.** Kelley, J.E.; Leavenworth, H.W. Jr. (Bureau of Mines, Albany, OR (USA). Albany Research Center). 1980. Contract AI05-800R20687. 6p. NTIS, PC A02/MF A01.

This program is to evaluate (1) the erosion-resistance of valve materials and (2) materials processing methods for improved wear in coal conversion and utilization components. The research is organized into four tasks: erosion testing of potential valve materials at several particle velocities and impingement angles, support to Morgantown Energy Technology Center valve development program, liaison and consultation to DOE contractors on materials for wear resistance, and testing of laser-processed valve seats in coal ash. High-velocity particle-erosion tests resulted in identification of several bulk materials and coatings that have high erosion resistance. Among these materials were Ni + TiB_2 alloys that had erosion resistances equal to and up to three times that of the best commercial cemented tungsten carbide materials tested to date. Coatings that had very high erosion resistance included chemical-vapor-deposited SiC and Si_3N_4. Further study of these materials, including application to hardware for coal conversion components, is being considered by several industrial valve producing firms. A data bank containing erosion data for particle impingement at six different angles and four velocities was begun. Materials tested for the data bank thus far include type 316 stainless steel, Stellite 6B, type 440-C stainless steel, cast alloy HC-250, and cemented tungsten carbide K-68.

10116 **(DOE/PC/30026—T1) Study of ebullated bed fluid dynamics for H-Coal. Quarterly progress report No. 1, July 1-September 30, 1980.** Schaefer, R.J.; Rundell, D.N. (Amoco Oil Co., Naperville, IL (USA). Research and Development Dept.). Dec 1980. Contract AC22-80PC30026. 48p. NTIS, PC A03/MF A01.

Cold flow experiments were completed with kerosene, nitrogen, and HDS-2A (3/16" length) catalyst. Percent bed expansion, gas/liquid/catalyst holdups, and drift fluxes were determined for each test. Fluid dynamics data were obtained at HRI during Run PDU-10 (Wyodak coal and Amocat-1A catalyst). Reactor liquid samples were taken for later viscosity determination. A 6" diameter test stand for bubble coalescence experiments was constructed and delivered to Northwestern University. A search was initiated to select suitable model fluids.

10117 **(DOE/PC/30141—T3) Project for laboratory study for removal of organic sulfur from coal.** (TRW Defense and Space Systems Group, Redondo Beach, CA (USA)). 15 Jan 1981. Contract AC22-80PC20141. 30p. NTIS, PC A03/MF A01.

Major accomplishments are listed: 1. It was found that molten sodium hydroxide (in place of mixed sodium and potassium hydroxides) followed by dilute sulfuric acid wash gave Gravimelt coal with the usual amount of sulfur and mineral matter removal but there was no MAF heat content loss over the small amount required for replacement of sulfur atoms by oxygen atoms in the coal structure - e.g., these samples had both measured heat content and MAF heat content in excess of 1400 Btu/lb. Therefore, the selectivity of the Gravimelt Process appears to be very high. 2. It was found that demineralized and desulfurizd Gravimelt coal has significantly less alkali metals content than the input coal. 3. Kentucky No. 11 coal was reduced in sulfur content to a level of 0.10 lbs of sulfur (0.20 lbs of sulfur dioxide)/10^6 Btu with an ash content of 0.21% in a cumulative reaction time of 60 minutes. This represents a 96% reduction in sulfur and a 97% reduction in ash. This product is significantly lower in sulfur content and ash than are typical synthetic or conventional liquid boiler fuels. 4. The Gravimelt Process was tested on Illinois No. 6 coal giving essentially identical results to those previously obtained for the Kentucky No. 11 coal under the same conditions (89% reduction in sulfur and 97% reduction in ash). 5. A technology for the regeneration of spent caustic has been identified within the tanning industry which corresponds to most of our Gravimelt Process requirements.

10118 **(DOE/PC/30252—T2) Hydrogen bonding in asphaltenes and coal liquids. Quarterly report, November 1, 1980-January 31, 1981.** Li, N.C.; Jones, L.; Yaggi, N.F. (Duquesne Univ., Pittsburgh, PA (USA). Dept. of Chemistry). 1981. Contract AC22-80PC30252. 24p. NTIS, PC A02/MF A01.

The aging characteristics of 30/70 (wt. %) blend of SRC I and SRC II and of a SRC II Middle Distillate (boiling point range 450 to 565°K), have been studied. Viscometric, electron spin resonance, ultimate analysis, solvent separations, gel permeation chromatography, and 600-MHz measurements have been used to monitor the aging properties of the SRC liquids under various conditions. The viscosity of the blend increases significantly in ten days with oxygen bubbling at 335°K. However, copper, in addition to oxygen, is necessary to significantly change the viscosity of the Middle Distillate. For the blend, there is a linear increase in the logarithm of viscosity with increasing wt. % of toluene-insolubles formed during oxygen-aging. There is also a linear decrease in the logarithm of viscosity with decreasing content of toluene-insolubles resulting from hydroprocessing of the blend with Ni-Mo catalyst. These observations indicate that under conditions of oxidative degradation the formation and content of larger molecular-size toluene-insolubles are mainly responsible for the increased viscosity of the blend. The middle distillate does not contain toluene-insolubles, and oxygen-aging occurs only in the presence of copper. Oxidative coupling of phenols is proposed as an aging mechanism for both the blend and the middle distillate.

10119 **(DOE/PETC/TR—81/1) Study of catalytic effects of mineral matter level on coal reactivity.** Mazzocco, N.J.; Klunder, E.B.; Krastman, D. (Department of Energy, Pittsburgh, PA (USA). Pittsburgh Energy Technology Center). Mar 1981. 72p. NTIS, PC A04/MF A01.

Coal liquefaction experiments using a 400-lb/day bubble-column reactor tested the catalytic effects of added mineral matter level on coal conversion, desulfurization, and distillate yields in continuous operation under recycle conditions, with specific emphasis on the use of a disposable pyrite catalyst indigenous to the feed coal. Western Kentucky No. 11 run-of-mine (ROM) and washed coals were used as feedstocks to determine the effects of levels of mineral matter, specifically iron compounds. Liquefaction reactivity as characterized by total distillate yield was lower for washed coal, which contained less mineral matter. Liquefaction reactivity was regained when pyrite concentrate was added as a disposable catalyst to the washed coal feed in sufficient quantity to match the feed iron concentration of the run-of-mine coal liquefaction test run.

10120 **(EPRI-AP—1610) Guide for the assessment of the reliability of gasification-combined-cycle power plants. Interim report.** Blair, J.; Witt, J.; Neely, M. (Arinc Research Corp., Annapolis, MD (USA)). Nov 1980. 178p. NTIS, PC A09/MF A01.

This guide is intended for use by utility personnel in assessing the reliability of coal-gasification combined-cycle (GCC) power plant designs. The assessment methodology deals with the estimation of a GCC plant's inherent operating reliability. The concept of inherent operating reliability assumes the performance of normal scheduled maintenance but precludes the consideration of corrective maintenance. The proposed system metric is tau_0 (the time required for the GCC plant to reach a predefined level of output), which is analogues to a mean time to failure for the entire plant. The guide presents a seven-step assessment methodology that uses the concepts of system states and state capability (the power output associated with each state) in conjunction with a matrix of state-transition probabilities to produce a time-varying estimate of GCC plant effectiveness. As an illustration, the method is used in this guide to prepare an assessment of an 1100-megawatt baseload GCC plant that employs seven gas turbines, one steam turbine, and five oxygen-blown gasifiers of the Texaco type. A failure-rate data base e. the major component level and a documented computer program are also included in the illustration.

10121 **(EPRI-AP—1624) Economic Evaluations of Energy Recovery options for oxygen- and enriched air-blown Texaco GCC power plants. Final report.** Beckman, R.F.; Coleman, B.S.; Dawkins, R.P.; Rao, A.D.; Ravikumar, R.H.; Smelser, S.C.; Stock, R.M. (Fluor Engineers and Constructors, Inc., Irvine, CA (USA)). Nov 1980. 321p. NTIS, PC A14/MF A01.

This report presents the results of preliminary process design and economic screening studies of seven integrated Texaco-based coal gasification/combined-cycle power plant systems. Previous reports have indicated that the oxidant feed and hot gasifier effluent cooling units are the most costly items in the gasification system and, thus, hold the greatest possibility of being reduced. Therefore, the systems examined reflect combinations of two types of coal oxidant (98 percent oxygen and enriched air containing 35 percent oxygen) and four gas cooling options. Also presented is an eighth process design (without economics) of the most efficient of the seven systems under the more favorable ISO ambient conditions, rather than summer conditions. Except for the gasifiers and associated high-temperature heat recovery equipment, all of the combined-cycle designs in this report use commercially available components, including the gas turbines. The gasifier performances are based on extrapolations of the pilot plant gasifiers from mid- to the late 1980s. The high-temperature heat recovery equipment designs have not been demonstrated as full-sized equipment. The first and major objective was to determine whether or not oxygen-blown Texaco-based gasification combined-cycle power plants employing current technology combustion turbine (2000°F), could produce electricity at a competitive cost to that produced in a conventional coal-fired steam plant using limestone scrubbers for SO_2 removal. When all the cases are compared and referred to earlier studies, it is concluded that oxygen-blown Texaco GCC plants employing current technology (2000°F) combustion turbines produce electricity that is cost competitive with electricity produced by a conventional coal-fired steam plant with stack gas scrubbers designed to meet 1978 New Source Performance Standards.

10122 **(EPRI-AP—1625) Investigation of the liquefaction of partially dried and oxidized coals. Final report.** Cronauer, D.C.; Ruberto, R.G.; Silver, R.S.; Jenkins, R.J.; Davis, A. (Gulf Research and Development Co., Pittsburgh, PA (USA)). Nov 1980. 177p. NTIS, PC A09/MF A01.

This project was undertaken to determine the effect of predrying and partial oxidation on the liquefaction behavior of subbituminous coal. It was found from both micro- and bench-scale experiments that the drying of Belle Ayr subbituminous coal, even in nitrogen, results in a significant reduction of product yields when a comparison is made to similar runs using as-received coal. A further reduction occurs when the drying gas contains oxygen. As observed from a microscopic study of the reaction product residues, the yield reduction is due in part to a repolymerization of coal liquid products resulting in a sizable portion of coke-like solids. Samples of both Belle Ayr subbituminous and Powhatan bituminous coals were dried in various gases in three scales of equipment, namely, TGA and laboratory and bench-scale fluid bed units. The rates and maximum levels of coal oxidation are discussed in this report. It is noted that the lower rank coal oxidizes more readily, but the maximum up-take of oxygen is only about 3 wt % while that of the higher rank coal is about 8 wt %.

10123 **(EPRI-AP—1637) Design properties of steels for coal conversion vessels. Final report.** McCabe, D.E.; Landes, J.D. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). Nov 1980. 94p. NTIS, PC A05/MF A01.

This report contains the final results of a program to evaluate the fracture properties of pressure vessel steels in simulated coal conversion environments. This represents the first study in which a fracture mechanics approach was used to evaluate material properties in the aggressive high temperature and pressure environments typically encountered in coal conversion vessel operations. The overview of properties required for a fracture mechanics evaluation thus obtained can be used to identify potential problem areas in vessel operation. The materials evaluated in this study were 2 1/4 Cr-1 Mo pressure vessel steel weldments. The metallurgical conditions evaluated were A387, A542, base metal, weld metal, and heat-affected zone plus a simulation of 347 stainless steel weld overlay material. Five evaluation techniques were applied ranging in scope from subcritical crack growth to fracture toughness degradation. Environments used were 100% hydrogen and 6% H_2S-Bal H_2. Test conditions ranged from room temperature to 727°K (850°F) and pressures from 5.5 MPa (800 psi) to 24.1 MPa (3500 psi). The data developed in the present program were used to make some preliminary design calculations for example service conditions. The results indicated that successful operations are feasible despite severe material degradation but certain precautions should be taken with periodic inspections for flaws and prudent pressure-temperature control should be exercised. Several detailed observations are given.

10124 **(FE—2270-60) Solvent Refined Coal (SRC) process operation of solvent refined coal pilot plant, Wilsonville, Alabama. Quarterly technical progress report, April-June 1979.** (Catalytic, Inc., Wilsonville, AL (USA)). May 1980. Contract AC01-76ET10154. 145p. NTIS, PC A07/MF A01.

Operating conditions and experimental results obtained during the second quarter of 1979 at the Solvent Refined Coal (SRC) pilot plant in Wilsonville, Alabama, are presented and discussed. Kentucky 9 coal obtained from the Pyro Mining Company and the Lafayette Coal Company was processed. Material balances were completed for four of the six runs attempted during the quarter. Tests were conducted in the following operating modes: Using 75% of the dissolver volume, bypassing the dissolver completely, introducing part of the feed gas after the slurry preheater, and withdrawing slurry from the dissolver bottoms. The Kerr-McGee Critical Solvent Deashing (CSD) unit produced SRC containing 0.01 to 0.87% ash when operating at feed rates up to 350 lb/h. The median daily ash level in the product was 0.13%; and total deash-

ing solvent losses averaged 7.1% of the feed. Recovery of SRC ranged from 75.9 to 82.8%.

10125 **(FE—2270-70) Solvent refined coal (SRC) process operation of solvent refined coal pilot plant, Wilsonville, Alabama. Annual report, January-December 1979.** (Catalytic, Inc., Wilsonville, AL (USA)). Jan 1981. Contract AC01-76ET10154. 130p. NTIS, PC A07/MF A01.

Operating conditions and test results obtained at the six-ton-per-day Solvent Refined Coal (SRC-I) pilot plant in Wilsonville, Alabama, during 1979 are summarized. The plant was operated for a total of 284 days, or 78% of the year. Three coals were processed: Kentucky 6 and 11 and Kentucky 9 from the Pyro mine, and Kentucky 9 from the Lafayette mine. The coal space rate ranged between 25 and 50 lb/h-ft^3, dissolver conditions ranged between 1700 and 2100 psig at 825°F, and gas feed rates ranged from 6000 to 12,000 scfh. Conversion to cresol soluble organics ranged from 90 to 95 wt % of the MAF coal, while hydrogen consumption ranged from 1.3 to 2.7 wt % and SRC yield ranged from 45 to 75 wt % of the MAF coal. Mineral separation techniques studied included Critical Solvent Deashing (CSD) and vertical leaf filtration. SRC recoveries at the CSD unit ranged from 65 to 85 wt % of SRC in the CSD feed. Filtration rates of 4.4 gal/h-ft^2 of filter area were demonstrated with precoat. However, operation without precoat was unsuccessful.

10126 **(FE—2468-88) Workshop on critical coal conversion equipment, Huntington, WV, October 1-3, 1980.** Parker, H.W. (ed.). (Engineering Societies Commission on Energy, Inc., Washington, DC (USA)). Jan 1981. Contract AC01-77ET10679. 193p. NTIS, PC A09/MF A01.

Four simultaneous workshop sessions were held October 1-3, 1980, in Huntington, West Virginia, regarding the following components for coal conversion plants: slurry pumps, heat exchange equipment, compressors/expanders, and coal feed systems. Most of the 225 participants were engineering personnel active in existing coal conversion pilot plants or future demonstration plants. The participants reached the following conclusions. Hardware availability will not delay construction and operation of demonstration plants, but may result in non-optimum process equipment configurations. These demonstration plants will necessarily contain a few components which have not been demonstrated by long term tests, and thus maintenance and redesign of components may likely limit production levels in early years of operation. Limits on plant capacity and reliability due to using undemonstrated components could be significantly reduced by operation of a testing center or centers for coal conversion hardware. The testing centers are also needed for demonstration of second and third generation hardware. Further information exchanges specifically pertaining to the topics discussed in this workshop are desirable to facilitate development of a synfuels industry. A poll is being conducted to find a consensus regarding the best mechanisms for this information exchange.

10127 **(FE—2542-26) Pipeline gas demonstration plant. Phase I. Quarterly technical progress report, 1 October 1979-31 December 1979.** DiFulgentiz, R.A.; Leaman, G.J. Jr. (eds. and comps.). (Conoco, Inc., Stamford, CT (USA)). 1980. Contract EF-77-C-01-2542. 77p. NTIS, PC A05/MF A01.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the US Department of Energy requires Conoco Inc. to design, construct, and operate a demonstration plant for the manufacture of high-Btu gas from bituminous coal. The project is currently in the design phase. The main accomplishments during the reporting period were: (a) the process and engineering designs of the Demonstration Plant continued; (b) plans for obtaining the coal and coke feedstocks for Phase III operation of the Demonstration Plant were being developed; and (c) all of the baseline data required for the Environmental Report have been collected, analyzed, and the Environmental Assessment Report is in final editing. The technical progress during the reporting period is presented.

10128 **(FE—2547-58) Phase III laboratory support for H-Coal project.** (Hydrocarbon Research, Inc., Lawrenceville, NJ (USA)). Jan 1981. Contract AC05-77ET10152. 95p. NTIS, PC A05/MF A01.

Hydrocarbon Research, Inc. conducted a bench-scale program to determine optimum conditions for a Process Development Unit operation using Wyodak coal scheduled later in the Phase III Pilot Plant support program. The bench program was an extension of an earlier study of Wyodak coal in a PDU operation (Run 6, see Report FE/2547-26, November 1978). This 30-day, syncrude-mode operation was successful in determining the suitability of Wyodak coal for Pilot Plant operations. It also brought to light several areas which needed further study to improve the performance of this coal in an H-Coal system. Process operating conditions were modified for this program. These modifications included a lower reaction temperature while operating near hydrogen balance, and a different catalyst, Amocat 1A, which had demonstrated superior performance in previous testing. Overall, process performance was improved. Distillate yields were higher with less hydrogen consumption. Similar improvements in product yields and process economics should be possible in the later PDU operations using Wyodak coal, with the inclusion of the modified operating conditions tested in this bench-scale program. The first run of 23 days: 20 days at 31 lbs/h, ft^3 space velocity and 3 days at 18.5 S.V., demonstrated improvements in yield at lower hydrogen consumption and a product distribution that would support an integrated facility.

10129 **(FE—3245-21) Simultaneous high temperature removal of alkali and particulates in a pressurized gasification system. Annual technical progress report, October 1979-September 1980.** Mulik, P.R.; Ciliberti, D.F.; Alvin, M.A.; Ahmed, M.M.; Keairns, D.L. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Oct 1980. Contract AC21-78ET11026. 117p. NTIS, PC A06/MF A01.

An advanced low-Btu gasification system, when integrated with a combined cycle power plant, results in one of the most promising concepts for using low-Btu gasifiers, and hence leads the way to using high-sulfur coal. Using this coal to generate a fuel gas requires the removal of contaminants (especially alkali and particulates) which could lead to corrosion, erosion, and deposition problems on turbine materials. A cleanup system is therefore obligatory. In the present study, Westinghouse is examining the feasibility of a hot gas cleaning process to minimize the concentration of alkali in a high-temperature fuel gas with simultaneous particulate removal through the use of aluminosilicate materials (getters). There are four program objectives. The gettering capacity will be kinetically defined by thermogravimetric analysis of three selected getters - kaolinite, ash from a low-temperature coal char, and ash from a high-temperature gasifier. Using detailed chemical and physical analyses of the reacted aluminosilicates, the gettering mechanism will be delineated as either a chemical or a sorption process. System performance projections, for a coupled alkali and particulate removal system, will be developed from the fundamental kinetic and thermodynamic data. Finally, the system performance projections will be utilized to define a plan for concept scale-up.

10130 **(JPL—5030-437(Rev.A)) Instrumentation and control for fossil energy processes. Volume II. Requirements.** (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Dec 1980. Contract AI01-76ET10202. 28p. NTIS, PC A03/MF A01.

This document is issued to enhance the reporting and transfer of technology relating to instrumentation and control requirements for fossil energy processes. Circulation is to over 3200 interested members of the private and public sectors of the fossil energy community. This release is comprised of two volumes. Volume II contains functional specifications and will be updated quarterly. This release deals with two of the afore-mentioned generic problem areas, multi-phase mass flow and temperature. Each functional specification is divided into two pages. The first page, characterization, is a parametric definition of the measurement. The second page, restrictions, are those constraints placed upon the measurement device by performance, environment, and mechanical considerations. Each set of generic problems is preceded by the set of definitions which was utilized in gathering the data. Wherever possible industry standards such as ISA S51.1 were used as the terminology definition.

10131 **The development, description and status of the retrofittable AISI/EPA coke door seal.** Hoffmann, A.O.; Paul, R.L. *Ironmaking Proceedings, Metallurgical Society of AIME* ; **38**: No. 1979, 246-251(1979).

A description of work carried out by Battelle-Columbus Laboratories under the sponsorship of the Industrial Environmental Research Laboratory of EPA and the AISI to develop seal which could be retrofittable to existing coke ovens. The recommended seal consists of a carbon steel mounting angle and a simple two-bend main seal with one 'back-up' leaf, both manufactured in Inconel X-750. The back-up leaf aids in the distribution of stresses along the main seal. This design is intended to be retrofittable to both Koppers and Wilputte doors.

10132 **(ORNL—5664) Liquefaction technology assessment. Phase I: indirect liquefaction of coal to methanol and gasoline using available technology.** Wham, R.M.; Fisher, J.F.; Forrester, R.C. III; Irvine, A.R.; Salmon, R.; Singh, S.P.N.; Ulrich, W.C. (Oak Ridge National Lab., TN (USA)). Feb 1981. Contract W-7405-ENG-26. 403p. NTIS, PC A18/MF A01.

This first phase of a technical and economic assessment of coal liquefaction technology covers indirect liquefaction of a western United States subbituminous coal using Lurgi dry-ash gasifiers. Major liquefaction technologies employed were ICI low-pressure methanol synthesis and Mobil-MTG conversion of methanol to gasoline. Four major cases were studied, representing different product slates. In each case, the economic study was based on the detailed process design of a conceptual, self-sufficient, commercial facility using a coal feed rate to the gasifiers of 16,000 tons per stream day on a moisture- and ash-free basis. This corresponds to a total as-received coal feed rate of approx. 30,000 TPSD to the facility. Process designs, equipment summaries, cost estimates, and operating requirements were prepared by Fluor Engineers and Constructors, Houston Division, under a subcontract to ORNL. Economic calculations to determine product prices under various conditions were made by ORNL using Fluor's capital costs and operating requirements. Base-case economic conditions included 100% equity financing at 12% annual after-tax return on equity, no inflation, and a coal price of $\$1.00/10^6$ Btu. Calculations were made by the ORNL discounted cash flow program PRP. The product price corresponds to a production cost at the plant gate and includes taxes and return on investment. Economic sensitivity studies showed that the two factors having the greatest influence on product price were the method of financing and the inclusion of escalation of inflation. Depending on the financing assumptions, the initial gasoline selling price in 1979 dollars varied from $0.78 to $1.25/gallon. This price must be escalated at 6%/yr to obtain the price in the start-up year, or in any other year of operation. These and other results of the study are discussed in detail with the assumptions involved given explicitly. (LTN)

10133 **(PB—80-188378) Coal gasification/gas cleanup test facility: Volume I. description and operation. Final report Sep 77-Dec 78.** Ferrell, J.K.; Felder, R.M.; Rousseau, R.W.; McCue, J.C.; Kelly, R.M. (North Carolina State Univ., Raleigh (USA). Dept. of Chemical Engineering). Mar 1980. 108p. NTIS, PC A06/MF A01.

The report describes an integrated fluidized-bed coal gasification reactor and acid gas removal system. The gasifier operates at 100 psig at up to 2000 F, and has a coal feed capacity of 50 lb/hr. The gas cleaning system contains a cyclone, a venturi scrubber, and an absorber/flash-tank/stripper system for acid gas removal. The overall objective of the research carried out using the facility is to characterize completely the gaseous and condensed phase emissions as a function of plant operating conditions. The report contains a detailed description of the plant and associated facilities, a summary of operating procedures, and results of a run for the steam-oxygen gasification of a Western Kentucky No. 11 coal char. By following the outlined operating procedures, the plant can be brought to steady state in less than 4 hours. At steady state, satisfactory material balance closures were achieved on total mass and major elements.

10134 **(PB—80-811383) Desulfurization of coal and petroleum. 1978-June, 1980 (citations from the NTIS data base). Report for 1978-Jun 80.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 183p. NTIS PC N01/MF N01.

The two part bibliography covers aspects of coal and petroleum fuel desulfurization relating to coal preparation, coal liquids, the gasification of coal, and crude oil preparation, where the processes specifically accomplish desulfurization before combustion of the fuel. Coal liquefaction and gasification are only included if sulfur removal is stressed. Flue gas desulfurization and other post-combustion sulfur control processes are excluded. (This updated bibliography contains 173 abstracts, 54 of which are new entries to the previous edition.)

10135 **(PB—80-811391) Coal gasification technology. 1977-1978 (citations from the American Petroleum Institute data base). Report for 1977-78.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 181p. NTIS PC N01/MF N01.

This bibliography cites studies relating to the coal gasification processes. Topics include design, equipment used, performance, and cost analysis. Coal desulfurization, cleaning, or preparation, which do not involve conversion to fuels or chemicals, are not covered. (This updated bibliography contains 174 abstracts, none of which are new entries to the previous edition.)

10136 **(PB—80-811409) Coal gasification technology. 1979-March, 1980 (citations from the American Petroleum Institute data base). Report for 1979-Mar 80.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 423p. NTIS PC N01/MF N01.

Studies on coal gasification are cited. Topics include design, performance, cost analysis, and equipment used. Coal desulfurization, cleaning, or preparation, which do not involve conversion to fuels or chemicals are not covered. (This updated bibliography contains 416 abstracts, all of which are new entries to the previous edition.)

10137 **(PB—80-811417) Coal liquefaction technology. 1978-1979 (citations from the American Petroleum Institute data base). Report for 1978-79.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 198p. NTIS PC N01/MF N01.

Techniques and processes for the conversion of coal to liquid chemicals and fuels are cited in this bibliography covering world-wide literature. Included are studies covering in-situ combustion, process equipment, design, and performance. Coal desulfurization, cleaning, or preparation which does not directly involve the liquefaction process are not covered. (This updated bibliography contains 188 abstracts, none of which are new entries to the previous edition.)

10138 **(PB—80-811425) Coal liquefaction technology. 1979-March, 1980 (citations from the American Petroleum Institute data base). Report for 1979-Mar 80.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 329p. NTIS PC N01/MF N01.

Techniques and processes for the conversion of coal to liquid chemicals and fuels are cited in this bibliography covering world-wide literature. Included are studies covering in-situ combustion, process equipment, design, and performance. Coal desulfurization, cleaning, or preparation which does not directly involve the liquefaction process are not covered. (This updated bibliography contains 318 abstracts, all of which are new entries to the previous edition.)

10139 **(SAND—80-1526C) Materials selection for high-pressure letdown valves in coal-liquefaction systems.** Randich, E. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 26p. (CONF-810417—1). NTIS, PC A04/MF A01.

From 90. AICHE national meeting; Houston, TX, USA (5 Apr 1981).

The high pressure letdown valve used in coal liquefaction processes must operate in a coal/ash/solvent slurry at 520 to 720 K

and with letdown pressures from 1.0 x 10^7 to 2.0 x 10^7 Pa. The slurry is corrosive and extremely erosive. Proper materials selection which, for this application, has ranged chronologically from stainless steels, to stellite alloys, to cemented carbides is imperative for long lifetime components. The interdependence sound of mechanical design and materials selection is reviewed. The properties that make a given material erosion resistant are presented. Erosion performance of advanced ceramic materials such as SiC, Si_3N_4, B and TiB_2 are evaluated, and their possible use as coatings discussed.

10140 **(UCRL-Trans—11631) Effect of coal thickness and structure and of coal quality on indices of the underground coal gasification process (according to operating data for gas generators of the Moscow Podzemgaz Station).** Korolev, I.V. Translated from *Nauchnya Trudy, Vsesoyuznyi Nauchno-Issledovatel'akii Podzemnoi Gaz;* 7: 27-32(1962). 15p. NTIS, PC A02/MF A01.

Coal seams of any thickness can be used for underground gasification. However, in the gasification systems currently in use, gas with a conditional combustion heat is obtained in coal seams over 1 m thick. Engineering and economic calculations show that in order to achieve profitable operation of a Podzemgaz station, the thickness of a seam of simple structure must be at least 1.3 m. The best process indices for UCG may be anticipated in coal seams 2.0 to 4.0 m thick. In order to obtain satisfactory technical and economic indices for the UCG process, the ash content, referred to absolutely dry fuel, in the seams being worked must not exceed 40%. A high ash content significantly worsens the indices of the UCG process. Coal seams of complex structure, i.e., seams which contain rock interbeds, gasify with lower technical and economic indicators than do seams of simple structure. When the rock interbeds in the coal seam amount to over 30% of the total thickness of the coal bands, an UCG process cannot be set up with satisfactory process indices. If the content of rock interbeds in the seam is over 30%, then the seam is deemed noncommercial. Coal intercalations with an ash content of 40 to 50% also should be classified as rock interbeds in seams of complex structure, since, although they are partially subjected to gasification, because they have low permeability and a low carbon content, they impede the normal course of the UCG process.

10141 **(DOE/ET/10104—T4(Vol.2)(Pt.1)) Solvent refined coal (SRC) process. Annual technical progress report, January 1979-December 1979.** (Pittsburg and Midway Coal Mining Co., Englewood, CO (USA)). Nov 1980. Contract AC05-76ET10104. 402p. NTIS, PC A18/MF A01.

A set of statistically designed experiments was used to study the effects of several important operating variables on coal liquefaction product yield structures. These studies used a Continuous Stirred-Tank Reactor to provide a hydrodynamically well-defined system from which kinetic data could be extracted. An analysis of the data shows that product yield structures can be adequately represented by a correlative model. It was shown that second-order effects (interaction and squared terms) are necessary to provide a good model fit of the data throughout the range studied. Three reports were issued covering the SRC-II database and yields as functions of operating variables. The results agree well with the generally-held concepts of the SRC reaction process, i.e., liquid phase hydrogenolysis of liquid coal which is time-dependent, thermally activated, catalyzed by recycle ash, and reaction rate-controlled. Four reports were issued summarizing the comprehensive SRC reactor thermal response models and reporting the results of several studies made with the models. Analytical equipment for measuring SRC off-gas composition and simulated distillation of coal liquids and appropriate procedures have been established.

10142 **(DOE/ET/10104—T4(Vol.2)(Pt.2)) Solvent refined coal (SRC) process. Annual technical progress report, January 1979-December 1979.** (Pittsburg and Midway Coal Mining Co., Englewood, CO (USA)). Nov 1980. Contract AC05-76ET10104. 342p. NTIS, PC A15/MF A01.

This report discusses the effects on SRC yields of seven process variables (reactor temperature, SRT, hydrogen partial pressure, recycle ash and coal concentrations, gas velocity and coal type) predicted by second-order regression models developed from a data base containing pilot plant data with both Kentucky and Powhatan coals. The only effect of coal type in the model is a shift in each yield by a constant factor. Although some differences were found between the models developed from the Kentucky data base (1) (which we call Kentucky models) and the pooled coal models, the general conclusions of the previous report are confirmed by the new models and the assumption of similar behavior of the two coals appears to be justified. In some respects the dependence of the yields (MAF coal basis) on variables such as pressure and temperature are clearer than in the previous models. The principal trends which emerge are discussed.

10143 **Recuperative coke oven and process for the operation thereof.** Flockenhaus, C.; Hartkopf, E. (to Bergwerksverband Gmbh (Germany, F.R.); Didier Engineering Gmbh (Germany, FR)). US Patent 4,222,824. 16 Sep 1980. vp.

A recuperative coke oven includes at least one recuperator chamber arranged below an oven chamber. Hot undergrate firing exhaust gas is passed from the oven through the recuperator chamber. At least one elongated recuperator extends into the recuperator chamber. The recuperator includes an inner tube and a coaxially outer tube. The inner end of the inner tube is open, and the inner end of the outer tube is closed to define an annular chamber between the two tubes. Combustion air to be heated is introduced into the inner tube and passed therethrough. The combustion air then reverses direction and passes through the annular chamber and is thereat heated by the hot exhaust gas passing through the recuperator chamber. The heated combustion air is discharged from the annular chamber and passed to the heating flues of the oven. The length of the recuperator positioned within the recuperator chamber may be adjusted by relative sliding movement of the recuperator, to thereby change the available heat exchange surface of the recuperator and to thus regulate the temperature of the heated combustion air.

10144 **Use of once-through treat gas to remove the heat of reaction in solvent hydrogenation processes.** Nizamoff, A.J. (to Exxon Research And Engineering Co). US Patent 4,222,844. 16 Sep 1980. Filed date 8 May 1978. vp.

In a coal liquefaction process wherein feed coal is contacted with molecular hydrogen and a hydrogen-donor solvent in a liquefaction zone to form coal liquids and vapors and coal liquids in the solvent boiling range are thereafter hydrogenated to produce recycle solvent and liquid products, the improvement which comprises separating the effluent from the liquefaction zone into a hot vapor stream and a liquid stream; cooling the entire hot vapor stream sufficiently to condense vaporized liquid hydrocarbons; separating condensed liquid hydrocarbons from the cooled vapor; fractionating the liquid stream to produce coal liquids in the solvent boiling range; dividing the cooled vapor into at least two streams; passing the cooling vapors from one of the streams, the coal liquids in the solvent boiling range, and makeup hydrogen to a solvent hydrogenation zone, catalytically hydrogenating the coal liquids in the solvent boiling range and quenching the hydrogenation zone with cooled vapors from the other cooled vapor stream.

10145 **Method for in situ gas production from coal seams.** Sabol, K. US Patent 4,222,437. 16 Sep 1980. vp.

Gas is produced and extracted from a coal deposit by drilling a row of supply wells in the deposit for receiving air or another combustion supporting gas, cutting horizontal inclined supply passages along the bottom of the deposit extending from the bottom end of the supply wells to a channel at the other end of the deposit perpendicular to and interconnecting the supply passages, igniting the coal face in the channel to create a combustion zone, maintaining combustion by continuously supplying air to the combustion zone via the supply wells and supply passages, and continuously removing gases produced by combustion via a central discharge passage extending along the deposit parallel to the supply passages and production wells drilled from the surface to the discharge passage in a row perpendicular to the row of supply wells.

10146 **Integrated coal liquefaction-gasification-naphtha reforming process.** Schmid, B.K. (to Gulf Oil Corp). US Patent 4,222,845. 16 Sep 1980. Filed date 13 Dec 1978. vp.

An integrated coal liquefaction-gasification-naphtha reforming process wherein the slurry containing substantially the entire

yield of normally solid dissolved coal produced in the liquefaction zone constitutes the only hydrocarbonaceous feed for the gasification zone and wherein substantially all of the naphtha fraction produced in the liquefaction zone is passed through the reforming zone for conversion to gasoline. The cost in terms of thermal efficiency for performing the reforming step is very low when the amount of syngas produced in the gasification zone is adequate to provide upon direct combustion a considerable proportion of the fuel requirements of both the liquefaction and reformer zones.

10147 **Coal liquefaction-gasification process including reforming of naphtha product.** Schmid, B.K. (to Gulf Oil Corp). US Patent 4,222,846. 16 Sep 1980. Filed date 13 Dec 1978. vp.

A combination coal liquefaction-gasification-naphtha reforming process wherein the slurry containing substantially the entire yield of normally solid dissolved coal produced in the liquefaction zone comprises substantially the only hydrocarbonaceous feed for the gasification zone and wherein a portion of the naphtha produced in the liquefaction zone is passed through the reforming zone for conversion to gasoline with the remainder of the naphtha being burned as fuel within the process. The amount of hydrocarbonaceous material charged to the gasification zone is established so that the thermal efficiency of the process is substantially unaffected by changes in the ratio of naphtha passed through the reforming zone to naphtha burned as process fuel. The thermal efficiency of the process is maintained at a high level regardless of minor variations in normally solid dissolved coal yield by changing the ratio of naphtha passed through the reforming zone to naphtha burned as process fuel.

10148 **Coal liquefaction process with improved slurry recycle system.** Carr, N.L.; Schmid, B.K. (to Gulf Oil Corp). US Patent 4,222,847. 16 Sep 1980. Filed date 15 Dec 1978. vp.

In a coal liquefaction process including recycle of a product slurry comprising normally solid dissolved coal and mineral residue, the minimum slurry recycle rate is determined by a pumpability constraint on the solids level of the slurry contained in the feed coal mixing vessel. If the solids level in the feed coal mixing vessel rises above the constraint level, the slurry recycle rate must increase. For coals which generate a high mineral residue content, adequate dilution of the slurry in the feed coal mixing vessel requires the slurry recycle rate to rise to an economically impracticable level. In the present process, mechanical operability is improved and enhanced conversion of normally solid dissolved coal is achieved at a given constraint solids level by passing a portion of the liquefaction zone product slurry through a hydroclone with the hydroclone overflow stream constituting a second recycle slurry. Deployment of the second recycle slurry increases the proportion of relatively small more catalytically active particles of mineral residue within the process.

10149 **Coal liquefaction process employing extraneous minerals.** Carr, N.L.; Schmid, B.K. (to Gulf Oil Corp). US Patent 4,222,848. 16 Sep 1980. Filed date 15 Dec 1978. vp.

In a coal liquefaction process which includes a recycle of a product slurry which contain recycle mineral residue and recycle of extraneous catalytic material to said liquefication zone, hydrocracking of the hydrocarbonaceous material from the mineral residue occurs and a mixture of hydrocarbon gases, dissolved liquid, normally solid dissolved coal, suspended mineral residue and suspended extraneous catalytic mineral results. A first portion of said residue slurry is recycled to the liquefication zone, a second portion is passed to separation means and the third portion goes to a hydroclone. Overflow from the hydroclone goes to the liquefaction zone to reduce the median diameter of the particles recycled.

10150 **Process of liquefaction of coal.** Shimizu, K. US Patent 4,222,849. 16 Sep 1980. Filed date 5 Jul 1979. vp.

Liquefaction of coal is realized in a chemical manner without employing high temperature and high pressure, only by such a process, wherein granulated coal is first soaked in aqueous solution of caustic soda and subsequently pulverized after it is taken out and dried, and then, the so obtained coal powder is mixed with an aqueous solution containing sodium hydroxide and organic carboxylic acid by agitation, thereafter the mixture is kept still for sufficient time until the coal becomes ominous of liquefaction, and finally, the mixture is heated at a temperature from 90° to 150° C. With further addition of water.

10151 **Catalytic hydrogenation process and apparatus with improved vapor liquid separation.** Chervenak, M.C.; Comolli, A.G. (to Hydrocarbon Research Inc). US Patent 4,221,653. 9 Sep 1980. Filed date 30 Jun 1978. vp.

A continuous hydrogenation process and apparatus wherein liquids are contacted with hydrogen in an ebullated catalyst reaction zone with the liquids and gas flowing vertically upwardly through that zone into a second zone substantially free of catalyst particles and wherein the liquid and gases are directed against an upwardly inclining surface through which vertical conduits are placed having inlet ends at different levels in the liquid and having outlet ends at different levels above the inclined surface , such that vapor-rich liquid is collected and discharged through conduits terminating at a higher level above the inclined surface than the vapor-poor liquid which is collected and discharged at a level lower than the inclined surface.

10152 **Hydroprocessing coal liquids.** Cabal, A.V.; Heck, R.H.; Stein, T.R. (to Electric Power Research Institute). US Patent 4,221,654. 9 Sep 1980. vp.

Compatibility of solvent refined coal and other coal liquids with conventional petroleum fuels is improved by moderate catalytic hydrogenation of the solvent refined coal liquid to a hydrogen to carbon atomic ratio less than that of corresponding petroleum fractions. As degree of hydrogenation of solvent refined coal is increased, compatibility with petroleum fractions of like boiling range increases to a maximum measured by precipitation of sediment from the blend of equal parts of the two fuels. That maximum is achieved at a hydrogen/carbon ratio below that of the corresponding petroleum fractions. As that ratio is increased toward the ratio characteristic of a like petroleum fraction, compatibility is impaired.

10153 **Process for gasifying pelletized carbonaceous fuels.** Ban, T.E.; Marlowe, W.H.; Sheppard, J.C. (to Mcdowell-Wellman Co). US Patent 4,220,454. 2 Sep 1980. Filed date 29 Dec 1978. vp.

A process is disclosed for gasifying pelletized coal to produce a low btu gas containing large amounts of hydrogen and carbon monoxide. Advantageously, the process is carried out on a circular traveling grate machine on a continuous basis. A horizontally moving, quiescent, gas-permeable bed of coal is formed by depositing at least one layer of a sized recycle charge of coal and at least one layer of fresh coal. To initiate an oxidizing reaction zone, the surface of one of the layers is ignited and the zone travels as a wave downwardly into the layer and upwardly into any superposed layer. Air and steam or air and carbon dioxide are either updrafted or downdrafted through the bed to control combustion. The coal is reduced in zones ahead of the advancing zone or zones of oxidation, and the reactions are terminated before the oxidation zone reaches both outermost surfaces of the bed to minimize the formation of carbon dioxide. Unreacted coal is separated from fine ash and is used as the recycle feed.

10154 **Method for producing reduction gases consisting essentially of carbon monoxide and hydrogen.** Tippmer, K. (to Still, Carl Firma (Germany, Federal Republic Of)). US Patent 4,220,469. 2 Sep 1980. vp.

A single heat method of producing reduction gases which consist essentially of carbon monoxide and hydrogen for ore-reducing processes, comprises, directing a coal and water suspension into a reactor to generate combustion gases under pressure having a temperature in the range of from 1300° C. To 1500° C. And mixing the combustion gases immediately after they are formed with reduction furnace waste gases which have a temperature in the range of from 100° C. To 500° C. The mixed gases are then directed through a water seal separator to separate and quench slag particles and the slag particles are removed with water from the gas stream. The pressure gases are mixed with the waste gases in a proportion of from 1:0.5 to 1:2.0. The resultant gases after purification and hydrogen sulfide scrubbing are directed back into the ore-reducing process and the quenched slag particles are fused to larger size ag-

glomerates and are carried out of the gas stream and taken up in water.

10155 Method for recovering coal in situ. Steeman, J.W. (to Stamicarbon B V (Netherlands)). US Patent 4,220,203. 2 Sep 1980. vp.

For the purpose of in-situ recovery of coal a borehole is driven from the surface in the plane of the coal over at least a large part of its travel, as far as conditions permit. At or near its end this borehole is widened over such a length and to such a width as corresponds with at least twice the deviation to be expected in the horizontal projection of a second borehole which is driven so far as to connect the widened section described above. The widened section is preferably made with the aid of mechanical means. After the boreholes have been linked, the coal is recovered by gasification, dissolution or extraction, whether or not under supercritical conditions and whether or not with attendant chemical/physical disintegration. The method according to the invention is particularly suited for use in the 'in-line' gasification technique.

10156 U-GAS demonstration plant program. Patel, J.G.; Loeding, J.W. Chicago, IL; Institute of Gas Technology (1980). 19p. (CONF-8010150—1).

From Conference on synthetic fuels: status and directions; San Francisco, CA, USA (13 Oct 1980).

A joint program to design, construct, and operate an industrial fuel-gas demonstration plant in Memphis, Tennessee, has been undertaken by Memphis Light, Gas and Water Division (MLGW) and the US Department of Energy (DOE). The facility will use the Institute of Gas Technology's U-GAS process to produce fuel gas equivalent to 50 million cubic feet per day of natural gas. The plant will use as feed 3200 tons/day of western Kentucky coal. To date, main activities have been the design of the plant and, in support of the design, operation of the U-GAS pilot plant, the compilation of an environmental report, and estimation of plant cost. This constitutes the work done under Phase I; Phases II and III, which will conclude detailed plant design and construction in Phase II and plant operations in Phase III, have been the subject of recent successful negotiations between DOE and MLGW. The cost of Phases II and III will be shared between the two signatories. The goal of the demonstration plant program is to test the feasibility of a multiple-user coal gasification plant located in the southwest corner of Memphis, Tennessee.

10157 Exploratory study of a combined sonic agglomeration and crossflow filtration system for hot gas cleanup. Rush, W.F. Jr.; Onischak, M.; Anderson, G.L.; Babu, S.P. Chicago, IL; Institute of Gas Technology (1980). 19p. (CONF-801104—12).

From 73. annual meeting of the American Institute of Chemical Engineers; Chicago, IL, USA (12 Nov 1980).

A combined sonic agglomeration/crossflow filtration system to remove particles smaller than 10 microns from high-temperature, high-pressure gas streams was investigated. Sonic energy induces agglomeration, so that particles can be removed in a continuously operating crossflow filter element. Cold-model and preliminary high-temperature, high-pressure results are promising.

0106 Properties

10158 (DOE/ET/10527—T1, pp 258-271) Effect of structure on coal reactivity. Sep 1980.

In Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Final report.

The effect of $ZnCl_2$ on the properties of a medium volatile coal are similar to those observed with a high volatile coal. Upon heating the coal impregnated with $ZnCl_2$, hydrogen is evolved from hydroaromatic groups in the range 200 to 400°C. In the absence of $ZnCl_2$, hydrogen is not evolved below 400°C. The change in the hydroaromatic structure of the coals results in lower volatile matter evolution above 400°C. A similar effect is observed in lignite, but the magnitude is much less due to the lower hydroaromatic content. Asphaltenes obtained by coal hydrogenation are shown to contain hydroaromatic structures that can be catalytically dehydrogenated with Pd. The asphaltenes can be reacted with HCl to produce acidic and basic fractions. The acidic fractions are of higher molecular weight and contain larger condensed ring aromatic systems and larger alkyl group substituents. The basic fraction is of lower average molecular weight. The asphaltenes contain many of the structural features of the original coal.

10159 (DOE/MC/11729—T1, pp 69-102) Chemical analyses of coal from the Blackhawk formation, Wasatch plateau coal field, Carbon, Emergy, and Sevier counties, Utah. Hatch, J.R.; Affolter, R.H.; Davis, F.D. Aug 1979.

In Coal studies: methane content of Utah coals; observations on the Sunnyside coal zone; chemical analyses of coal from the Blackhawk formation, Wasatch plateau Coal Field. Carbon, Emery, and Sevier counties, Utah. Special studies 49.

Fifty-two coal samples were collected from the Upper Cretaceous Blackhawk Formation in the Wasatch Plateau coal field in Carbon, Emery, and Sevier Counties, Utah. This report summarizes chemical analyses made on these 52 samples. Brief descriptions are given; sample locations are shown on a map. A statistical comparison (students t test, 94% confidence level) of the geometric means of the US Bureau of Mines data for 40 coal samples from the Blackhawk Formation with 86 other Rocky Mountain province coal samples shows that coal from the Blackhawk Formation has significantly higher contents of volatile matter, carbon, and organic sulfur and a significantly lower content of moisture and oxygen. The heat of combustion and contents of fixed carbon, ash, hydrogen, nitrogen, total sulfur, sulfate sulfur, and pyritic sulfur are not significantly different. A statistical comparison of the geometric means of the contents of coal ash and contents in ash of nine major and minor oxides for 52 coal samples from the Blackhawk Formation with 295 other Rocky Mountain province coal samples shows that coal ash from the Blackhawk Formation has significantly higher contents of SiO_2 and N_2O and significantly lower contents of Al_2O_3, MgO, and SO_3. The contents of ash and contents of CAO, K_2O, Fe_2O_3, and TiO_2 in ash are not significantly different. A statistical comparison of the geometric mean-contents for 36 elements from 52 coal samples from the Blackhawk Formation with 295 other Rocky Mountan province coal saples shows that coal from the Blackhawk Formation has significantly higher contents of Na, B, Be, Cr, Nb, Ni, Se, Y, and Yb, and significantly lower contents of Al, Ca, Mg, Fe, As, Ba, Cd, F, Mn, Mo, Sb, Sr, Th, U, and V. The contents of Si, K, Ti, Co, Cu, Ga, Hg, Li, Pb, Sc, Zn, and Zr are not significantly different. When compared at the 99% confidence level, the contents of Fe, Be, and U are not significantly different.

10160 (DOE/PC/30088—2) Coal transformation chemistry. Second quarterly progress report, June 1, 1980-August 31, 1980. Stock, L.M. (Chicago Univ., IL (USA)). 1980. Contract AC22-80PC30088. 26p. NTIS, PC A03/MF A01.

A review of the information concerning the structure of Illinois No. 6 coal obtained in this laboratory and elsewhere provides the basis for a proposed structure for this bituminous coal. All the available facts concerning reduction, reductive alkylation, hydrogen atom exchange, oxidation, functional group analysis and so forth have been used to define a structural segment consisting of about 1000 atoms with a molecular weight in excess of 6000. This work is discussed in Part A. The study of the reductive alkylation reaction of Illinois No. 6 coal in liquid ammonia has been directed toward the optimization of the reaction conditions for the achievement of maximum solubility. The latest results indicate that about 55% of the original Illinois No. 6 coal can be converted to products which are soluble in tetrahydrofuran using potassium in liquid ammonia as the reducing agent and n-butyl iodide in tetrahydrofuran as the reducing alkylating agent. These observations are treated in Part B. The effort on donor solvent coal chemistry was directed to the role played by pericyclic reactions in the liquefaction process. The reactivity of a number of donors has been examined including 1,2- and 1,4-dihydronaphthalene. Although the research is not yet complete, the preliminary results indicate that free radical processes occur preferentially. Thus, the pericyclic reactions appear to be unimportant at the threshold reaction temperatures of 350 to 425°C. This work is described in Part C.

10161 **(DOE/PC/30230—T1) Phase equilibrium properties of coal-derived liquids. Technical progress report, July-December 1980.** Yesavage, V.F.; Kidnay, A.J. (Colorado School of Mines, Golden (USA). Dept. of Chemical and Petroleum Refining Engineering). 1 Jan 1981. Contract FG22-80PC30230. 10p. NTIS, PC A02/MF A01.

A wide variety of methods have been used to study the phase behavior of mixtures, including: Measuring the phase boundary of binary mixtures, observing property discontinuities from volumetric measurements, and thermal measurements of mixtures, measuring the composition of samples in batch systems, measuring the composition of samples from continuous remixing and separation in recirculating systems, gas-liquid chromatography, and measuring the composition of samples from a once-through flow system. A major difficulty associated with measuring phase behavior of complex mixtures is the need to characterize the vapor and liquid sample products. This generally requires the collection of considerable quantities of the liquid and vapor products. Of all the methods listed, the only method which can generate significant quantities of both liquid and vapor products is the once-through flow method. This method has been used previously in determining the K values for petroleum fractions. For these reasons, we have designed a flow equilibrium flash vaporization system similar to the ones previously used on petroleum liquids.

10162 **(EMD—78-3312) Applied coal petrography of some New Mexico coals: diffuse reflectivity of some New Mexico coals. Final report.** Kuellmer, F.J. (New Mexico Inst. of Mining and Technology, Socorro (USA). Dept. of Geoscience). Nov 1980. 36p. University of New Mexico, New Mexico Energy Inst., Albuquerque.

The present study measured the reflectance of finely-ground, lightly-compressed coal pellets over a broad range of wavelengths in the visible spectrum. Such compressed coal pellets eliminate the need for polishing in sample preparation. Because of the small grain size in the pellets, it is not possible to isolate the individual coal maceral (or coal component) to be measured. Intentionally, the measurement of the reflectivity of individual macerals is avoided. It was our desire to measure the reflectance over the entire visible spectrum and then allocate portions of this to the various macerals contributing to the spectrum. The basic assumption is that if a careful observer can selectively measure the relfectance of a specific coal maceral, the basis for selection is a physically observable parameter. It is possible that a different measuring procedure might define the relevant parameters in a manner not as dependent on the observer's judgement or on a favorable grain-size of texture. Moreover, such an approach might provide a more quantitative analytical understanding of various coals. It appears that we have developed a rapid, facile, and possibly more accurate method for making petrographic measurements useful in the blending of coals. The advantage to our data is that they represent a first set of measurements on a relatively crude measuring device adapted from another use. With improvements, and elimination of possible sources of errors, the predictive reliability might be considerably enhanced. The sample preparation is reduced to only fine grinding in a non-oxidizing atmosphere. It is not clear whether we have yet found the optimum method for correlating coal properties with spectral reflectivity but our data suggest a significant improvement.

10163 **Characterization of potential organic emissions from a low-Btu gasifier for coal conversion.** Hanson, R.L.; Royer, R.E.; Carpenter, R.L.; Newton, G.J. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM). pp 3-19 of Polynuclear aromatic hydrocarbons. Jones, P.W.; Leber, P. (eds.). Ann Arbor, MI; Ann Arbor Science Publishers Inc. (1979).

From 3. symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (Oct 1978).

Aerosols emitted from a low Btu research unit coal gasifier and cleanup system were analyzed. The compounds were primarily aromatics and alkyl- substituted aromatics. The distribution of these compounds between vapor, liquid and solid phase is dependent on the physical state of the gas and the treatment to which it was subjected. The gas cleanup system alters the material distribution by preferentially removing high molecular weight polycyclic aromatic hydrocarbons. It accomplishes this by transferring material from a vapor to a particulate phase and then separating the 2 phases. The degree to which these materials transfer to the particulate phase of coal gas aerosols is unknown. Components identified in extracts of filters from cleaned gas streams include phenanthrene, anthracene, methylphenanthrene isomer, dimethylphenanthrene isomer, fluoranthrene, pyrene and benzofluorene. (RJC)

0108 Waste Management

REFER ALSO TO CITATION(S) 10179, 10180, 10182, 10213, 10420, 10861, 11056, 11057, 11190, 11547, 11548, 11583, 11668

10164 • (ANL/EES-TM—(Vol.1), pp 379-393) **Status of synfuel wastewater treatability options.** Witmer, F.E. (Dept. of Energy, Washington, DC). Aug 1980.

From 12. IECEC conference on energy conservation in the treatment of industrial wastewaters; New Orleans, LA, USA (10 Dec 1979).

This presentation will overview the similarities and differences between the wastewater treatment/reuse schemes that are evolving for the different synfuel processes. Areas of environmental concern will be highlighted. The direction that future wastewater treatment technology is expected to take will be outlined. Coal conversion, oil shale processes, biomass conversion processes are discussed in relation to waste water treatment and disposal problems. (DMC)

10165 (CONF-800334—(Vol.1), pp 24-39) **Environmental control technology research in high sulfur coal preparation waste drainages.** Wagner, P.; Williams, J.M.; Wangen, L.E.; Bertino, J.P.; Wewerka, E.M.; Wanek, P.L.; Jones, M.M. (Los Alamos Scientific Lab., NM). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

Laboratory experiments have been performed to investigate the efficiency of several control options for treating coal wastes at the preparation plant, during or after disposal. Research revealed that calcining is one of the more effective and permanent means of treating high-sulfur coal wastes before disposal to decrease, quite dramatically, the release of environmentally undesirable pollutants into the drainages from disposal sites. Pretreatment of the waste by slurrying with lime/limestone mixtures, although still in the research stage, promises effective control of trace element releases and good economy. Another potential control method is codisposal of coal wastes with lime or limestone to neutralize the acid drainage and retain soluble aqueous contaminants within the waste site. Other experiments have examined the feasibility of using natural materials, such as clays, soils, and alkaline combustion products to attenuate through alkaline neutralization, sorbent, or ion exchange action, concentrations of trace elements of environmental concern in the waste pile effluents. The potential of contaminated effluent treatment using alkaline neutralization, ion exchange, and reverse osmosis has also been investigated. These results are discussed briefly. The various tradeoffs for these control options are considered in terms of contaminant reduction, complexity, permanency, and relative economics.

10166 (CONF-800334—(Vol.1), pp 42-54) **Reconnaissance and processing of impounded coal wastes in Alabama.** Browning, J.S. (Univ. of Alabama, University). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The data assembled from sampling of the various coal preparation plants in Alabama indicate that about 1,714,000 tons of fine-size waste are being discarded each year in Alabama, containing over 528,000 tons of recoverable coal. Clean coal products containing as little as 3 percent to as much as 11 percent ash can be obtained by heavy liquid separation. Fine coal which had been wasted in the past can readily be recovered as a clean commercial grade product by the use of gravity separation. A drilling technique has been developed for obtaining representative samples from impoundments to insure true samples of waste fine coal at all depths to the bottom of the impoundments. Drilling and sampling have been completed on waste fine impoundments in three areas.

10167 (CONF-800334—(Vol.1), pp 175-186) **Flue gas clean-up research at the Pittsburgh Energy Technology Center.** Strakey, J.P.; Joubert, J.I.; Ruether, J.R.; Peters, W.C. (Pittsburgh Energy Technology Center, PA). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

Research is underway at PETC on several aspects of advanced flue gas clean-up technology. This research is reviewed briefly in this paper. Processes being investigated include: dry scrubbing, a fluidized bed copper oxide process for simultaneous SO_2/NO/sub x/ removal, direct reduction of SO_2 to sulfur, absorption/steam stripping, and several aspects of the Resource Conservation and Recovery Act.

10168 (CONF-800334—(Vol.1), pp 269-279) **Status report on the environmental acceptability of spent FBC sorbent for agricultural uses.** Bennett, O.L.; Stout, W.J.; Hern, J.L.; Edwards, J.; Korcak, R. Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

A comprehensive research program is in progress to evaluate the potential of using FBC residue for agricultural uses throughout the Eastern United States. The results with field, greenhouse, growth chamber and laboratory studies indicate that the material can be used effectively for food and feed productions. At the present time we have found little evidence to indicate that this material would be detrimental to the food chain. However, studies with plants only indicate the short term effect of FBC residue on heavy metal uptake. It is absolutely essential that studies be conducted over a long period of time with repeated applications to the soil before final conclusions can be drawn. The soil is not a static situation and is continuously changing. Repeated heavy applications of FBC residue to the soil could cause a slow building of certain toxic heavy metals, or solubility and availability to plants can change with time. Therefore, we must evaluate soil management practices relative to FBC residue applications to crop land under as many different environmental conditions as possible before final judgment is made.

10169 (CONF-800334—(Vol.1), pp 280-312) **Status report on investigations dealing with commercial uses for atmospheric fluidized bed combustion residues.** Minnick, L.J. Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

An evaluation is being performed on potential commercial uses for solid wastes from fluidized bed systems. The investigation includes developing methods by which the material can be safely disposed of should commercial applications be slow in developing or not of sufficient magnitude. The program has involved several phases of activity and has used material from eight sources of supply. The first phase of the program is directed to the characterization of the wastes. A number of performance tests have been carried out to establish the feasibility of using the materials commercially. These include field tests and demonstrations. (DMC)

10170 (CONF-800334—(Vol.1), pp 387-396) **Zero liquid discharge for the Illinois coal gasification group demonstration plant.** Baczewski, K.C. (Dravo Corp., Pittsburgh, PA). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The waste treatment and disposal system being designed into the Illinois Coal Gasification Group Pipeline Gas Demonstration Plant is one of zero discharge. All water streams are recovered, treated and recycled, and all solid wastes are placed in landfills. The decision to design the plant in this manner has been made by ICGG in the early program phase, actually when the proposal to DOE was being prepared. The Demonstration Plant is designed to process 2300 tons per day of Illinois coal, with provisions to process Western and Pennsylvania coals as part of the program. The architect-engineer for the work is the Chemical Plants Division of Dravo Engineers and Constructors, who are designing all areas, including water and waste. This paper will confine itself to the Illinois case. The coal is pyrolyzed and gasified to obtain liquids and synthesis gas. The liquids are treated to produce 2100 barrels per day of naphtha and fuel oils. The synthesis gas is purified and then methanated to produce nearly 24 million cubic feet per day of pipeline gas. The water demand is approximately 900 gallons per minute, which is obtained from the Mississippi River, at a point nearly 20 miles away from the plant. The Wastewater treatment recovers 417 GPM to be recycled. The remaining water is lost by evaporation in the Cooling Towers and in process consumption.

10171 (CONF-800334—(Vol.1), pp 440-454) **Treatment of phenolic coal gasification effluents.** Luthy, R.G.; Campbell, J.R. (Carnegie-Mellon Univ., Pittsburgh, PA). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

Several research projects recently conducted at Carnegie-Mellon University have been directed towards evaluation of environmental problems associated with coal conversion processes. A portion of this work has focused on treatment of phenolic coal gasification process condensates. The purpose of these studies has been to define physicochemical and biological treatment characteristics of those wastewaters in order to obtain basic engineering and design data. The discussion summarizes the general scope and conclusions of these treatability studies with high-Btu coal gasification wastewaters.

10172 (CONF-800334—(Vol.1), pp 471-479) **Processing needs and methodology for condensate waters from coal conversion.** King, C.J. (Univ. of California, Berkeley). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

A contractors' workshop on the subject Processing Needs and Methodology for Wastewater from Coal, Oil Shale and Biomass Synfuel Processes was held in Germantown, MD, on June 14-15, 1979. This paper summarizes that report, which includes general conclusions from the workshop, as well as status reports of the projects represented by the participants. Purposes of the workshop were several-fold. Water usages and general effluent situations were first surveyed. Next an effort was made to identify probable and possible water-treatment goals and regulations which will be in effect at the time of construction of synfuels plants. Various components of present water-processing technology were identified, and the capabilities, shortcomings and probable costs of these were assessed. Particular attention was given to process reliability, which is a critical point for plants of the size and cost projected for synfuels operations. This then led to identification of water-related environmental-control problems which seem to be particularly severe. Finally, overall conclusions and recommendations were made.

10173 **(FE—2468-90) ESCOE engineering program. Quarterly report, September 1-November 30, 1980.** Rogers, K.A. (Engineering Societies Commission on Energy, Inc., Washington, DC (USA)). 4 Dec 1980. Contract AC01-77ET10679. 15p. NTIS, PC A02/MF A01.

ESCOE continues to perform work assignments at the request of the DOE Fossil Energy Technical Representative for the contract. ESCOE reviewed the EPA draft Pollution Control Guidance Document for low-Btu gasification technology, and prepared comments on the document for transmittal for DOE. At the request of DOE, ESCOE has been exploring ways in which ESCOE can follow up its work on the EPA bubble policy. The objective is to anticipate how changing environmental standards and policies may affect the major fossil energy projects. ESCOE is assisting DOE in establishing a program to review existing coal-liquids properties data. An initial step is to prepare a draft research agenda for improving the properties data base to meet fossil energy demonstration requirements. The agenda will serve as the basis for a workshop in early 1981. ESCOE is also conducting a heavy oil processing technology review for DOE.

10174 **(IS—4760) Advanced research and technology: direct utilization, recovery of minerals from coal fly ash. Fossil energy program. Technical progress report, July 1-September 30, 1980.** Burnet, G.; Murtha, M.J.; Adelman, D.J. (Ames Lab., IA (USA)). Dec 1980. Contract W-7405-ENG-82. 110p. NTIS, PC A06/MF A01.

This investigation is to develop methods for utilizing coal fly ash through processes for the extraction of alumina and titania, and

for the separation and use of an iron-rich fraction. Research of the HiChlor process for the extraction of alumina and titania by high-temperature chlorination of a fly ash-reductant mixture is described. An engineering cost evaluation is presented for a centralized HiChlor processing facility to process the fly ash of several large coal-fueled power stations. Investigations for a high-temperature lime-soda process for extraction of alumina from fly ash included the use of several types of quarry limestones and waste materials to replace the limestone and/or soda ash. A breakthrough was made on the development of a limestone-fly ash process without soda. The addition of less than 5% by weight waste coal refuse to the sinter mixtures increased alumina recoveries from a 55 to 90%, at a much lower sintering temperature of 1200°C. For the lime-soda sinter process, an engineering cost evaluation was prepared for a facility to process the fly ash from a 1000 MWe coal-fueled power station to produce alumina and Portland cement. This facility will process and dispose of the total generated fly ash volume as products rather than as waste, and the facility investment will be less than 10% of the cost of the corresponding power station. The magnetic fly ash fraction, separated before either HiChlor or sinter processing, was shown to have a market value as a heavy medium material for coal and ore beneficiation. Research was also conducted on the upgrading of magnetic fly ash to iron ore quality. Research of coal beneficiation using magnetic fly ash media was expanded.

10175 **(LBL—11031) Stripping of process condensates from solid fuel conversion.** Hill, J.D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 96p. NTIS, PC A05/MF A01.

Process condensates from the Solvent Refined Coal (SRC) Test Facility (Fort Lewis, Washington) and from the Omega-9 in situ oil shale retorting test (Rock Springs, Wyoming) were stripped batchwise at approximately 20°C using nitrogen. The gases leaving these solutions were passed through a train of absorbers, taking up ammonia and acid gases (carbon dioxide and hydrogen sulfide) successively. The amount of hydrogen sulfide absorbed was differentiated from carbon dioxide by selective precipitation as CuS using $CuCl_2$ solution. The solute concentrations (ammonia, carbon dioxide and hydrogen sulfide) in the solutions being stripped were measured by means of Orion specific-ion electrodes. These solute concentrations were determined at regular intervals throughout the stripping process; the concentration changes of the solutes were typically at most 5% during the interval between vapor pressure measurements. Stripping was continued until the indicated vapor pressures of all three volatile solutes fell below 0.01 mmHg. At this point either the solute was completely removed from the solution or the solute was held in solution by stoichiometric equivalence with one or more non-volatile cations or anions, and the pH began to change rapidly. The results are interpreted in terms of existing models of vapor-liquid equilibria for the NH_3-H_2S-CO_2-H_2O system, and in terms of the indicated concentrations of other cations and anions.

10176 **(PB—80-184765) Waste and water management for conventional coal combustion assessment report--1979. Volume IV. Utilization of FGC wastes. Final report Sep 77-Aug 79.** Santhanam, C.J.; Lunt, R.R.; Cooper, C.B.; Klimschmidt, D.E.; Bodek, I. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Mar 1980. 115p. NTIS, PC A06/MF A01.

The report, the fourth of five volumes, focuses on utilization of coal ash and FGD wastes. With increasing utilization of coal, generation of these wastes is expected to grow, but at a slower rate than generation, thus increasing the volume of wastes sent to disposal. Many uses for coal ash have been developed in three categories: as fill material; in the manufacture of cement, concrete, and pavements; and in miscellaneous uses such as ice control and blasting grit. In 1977, about 21% of the 61.6 million tons of coal ash generated was utilized. Current R and D projects on ash focus on understanding existing uses and developing new uses including mineral recovery. FGD wastes are not presently used in the U.S. Potential FGD utilization options may include use as gypsum substitutes, as fillers and soil conditioners, in cement and concrete manufacture, and construction of artificial reefs. Technical, environmental, and institutional barriers (the last being the most important) constrain utilization. Data gaps remain in quality requirements for using coal ash and FGD wastes in specific applications and understanding the institutional constraints to utilization.

0109 Environmental Aspects

10177 **(CONF-800334—(Vol.1)) Proceedings of the second US Department of Energy environmental control symposium. Volume 1. Fossil energy.** (Argonne National Lab., IL (USA)). Jun 1980. Contract W-31-109-ENG-38. 708p. NTIS, PC A99/MF A01.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

These proceedings document the presentations given at the Second Environmental Control Symposium. Symposium presentations highlighted environmental control activities which span the entire DOE. Volume I contains papers relating to coal preparation, oil shales, coal combustion, advanced coal utilization (fluidized bed combustion, MHD generators, OCGT, fuel cells), coal gasification, coal liquefaction, and fossil resource extraction (enhanced recovery). Separate abstracts for individual papers are prepared for inclusion in the Energy Data Base. (DMC)

10178 (CONF-800334—(Vol.1), pp 455-470) **Potential for control of pollutant production through process optimization.** Fillo, J.P.; Massey, M.J. (Environmental Research and Technology, Inc., Pittsburgh, PA). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The eventual commercial-scale development of coal conversion processes requires an assessment of their technical feasibility, potential environmental impacts and economic merit. An economical processing scheme must be developed that produces the primary product(s) while impacting on the environment at a minimum, as dictated by expected regulatory guidelines. The environmental characteristics of the process determine the need for utilizing environmental controls, their type and consequently their cost. As such, it is necessary to identify and evaluate potential routes in the total processing scheme that economically control the release of pollutants to the environment. This paper addresses two aspects of this problem: (1) the fate of potential pollutants during gasification; and (2) generic pollutant production patterns which might aid in extrapolation of PDU/pilot-scale data to demonstration/commercial scales of development. The environmental characteristics of any coal gasification process are a complicated function of the main processing scheme (i.e., gas production) and the types of control technology used to reduce pollutant emissions. The primary processing blocks consist of: production, release of potential pollutants from coal via chemical reaction during pretreatment and gasification; distribution, pollutant species partitioning during raw process gas quenching and gas processing; and control, removal of pollutant species from process streams that will eventually be discharged to the environment. The function of each of these blocks, as well as their role in affecting environmental characteristics, is discussed below.

10179 (CONF-800334—(Vol.1), pp 520-551) **Mechanisms of mine acid drainage formation and feasibility of abatement methods.** Paciorek, K.L.; Kimble, P.F.; Vatasescu, A.L.; Toben, W.A.; Kratzer, R.H. (Ultrasystems, Inc., Irvine, CA). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The mining of coal is frequently associated with the production of an acidic effluent which is caused by the degradation and dissolution of pyrite present in the majority of coal deposits. This problem is particularly pronounced and evident in the northern half of the Appalachian region and is considerably more severe in underground mining where acid production can continue and actually increase long after mine abandonment. In order to make possible a significant increase in coal production from underground mines without harmful effects on the environment or drastically increased treatment costs, the Department of Energy initiated this program with the objective to determine the mechanisms and kinetics of the acid formation processes and to identify technically and economically feasible methods of abatement and, ideally, complete prevention. The results obtained show that pyrite will undergo dissolution

upon exposure to air and water and that the rate of solubilization is a function of available surface area and temperature. Ferric ion does accelerate this process, cupric ion does not, and carbonates prevent acid formation. T. ferrooxidans and to a degree T. thiooxidans accelerate the rate of pyritic iron solubilization in coal. In regard to abatement methods the application of bactericides is pollution creating and will have only a temporary effect; recycling of ferrous iron containing water is ineffective based on the results obtained, and mine sealing or flooding may be hard to achieve. Promising approaches include making available carbonates present in coal and overburden to produce ferric oxides and hydroxides together with calcium sulfate; these should precipitate within the mine. Backfilling to reduce the amounts of water and air, which possibly could enter, to a minimum would offer another avenue with additional benefit of subsidence control.

10180 (CONF-800334—(Vol.1), pp 591-615) **Environmental control systems of the SRC-I Demonstration Plant.** Tao, J.C.; Yen, A.F. Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

How to operate the SRC-I Demonstration Plant near Newman, Kentucky at an environmentally acceptable level throughout the refining process is discussed. This report covers the following areas: process description; product environmental compliance; status of environmental controls; air emission controls; handling of aqueous wastes; solid waste disposal; sulfur balance; and investment in pollution control. (DMC)

10181 (CONF-800334—(Vol.1), pp 649-657) **Screening of hydrotreated coal liquids for mutagenic activity.** Sutterfield, D. (Bartlesville Energy Technology Center, OK); Lanning, W.C.; Royer, R.E. Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

Hydrotreated coal liquids and distillate coal liquid from the SRC-II process with hydrogen content from 8.4 to 12.24 wt % were screened for mutagenic activity using the Ames test. Results of the Ames assay indicated that mutagenic activity of the liquid product decreased by an order of magnitude for 35 percent removal of nitrogen and 52 percent removal of oxygen. Mutagenic activity of liquid product with 67 percent nitrogen removal and 82 percent oxygen removal was indistinguishable from that of the background samples. The full range of effect in decreasing mutagenic activity by the Ames assay was covered by relatively mild hydrotreatment, but assessment of potential human risk must be confirmed using additional mammalian tests.

10182 (CONF-800334—(Vol.1), pp 658-672) **H-Coal Pilot Plant environmental controls.** Gray, J.H. (Ashland Synthetic Fuels, Inc., KY). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

This report describes the H-Coal Pilot Plant in Catlettsburg, Kentucky. The generation of waste water, its source, treatment and disposal as well as water pollution control are discussed. Controlling the emission of hydrocarbons and sulfur dioxide to within acceptable levels within the plant is also covered. The processing and disposal of solid wastes generated during this process are also discussed. (DMC)

10183 (CONF-800334—(Vol.1), pp 673-690) **Environmental controls for the Exxon Donor Solvent Coal Liquefaction Process.** Green, R.C. (Exxon Research and Engineering Co., Florham Park, NJ). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The status of the development of environmental controls for the Exxon Donor Solvent (or EDS) Coal Liquefaction Process is described. Included is a brief description of the EDS process. Next will be a discussion of the project status, including a description of the progress in the construction of the 250 T/D Exxon Coal Liquefaction Pilot Plant, or ECLP. Some of the evironmental effects are predicted for a commercial EDS plant. The strategy for developing the environmental controls is discussed. The outlook for commercialization is covered.

10184 (DOE/EDP—0044) **Environmental development plan: coal liquefaction.** (Department of Energy, Washington, DC (USA)). Aug 1980. 78p. NTIS, PC A05/MF A01.

This Environmental Development plan (EDP) examines environmental concerns that are being evaluated for the technologies in DOE's Coal Liquefaction Program. It identifies the actions that are planned or underway to resolve these concerns while the technologies are being developed. Research is scheduled on the evaluation and mitigation of potential environmental impacts. This EDP updates the FY 1977 Coal Liquefaction Program EDP. Chapter II describes the DOE Coal Liquefaction Program and focuses on the Solvent Refined Coal (SRC), H-Coal, and Exxon donor solvent (EDS) processes because of their relatively advanced R and D stages. The major unresolved environmental concerns associated with the coal liquefaction subactivities and projects are summarized. The concerns were identified in the 1977 EDP's and research was scheduled to lead to the resolution of the concerns. Much of this research is currently underway. The status of ongoing and planned research is shown in Table 4-1.

10185 (DOE/ET/2548—3) **Environmental assessment of a contemporary coal mining system.** Dutzi, E.J.; Sullivan, P.J.; Hutchinson, C.F.; Stevens, C.M. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Dec 1980. Contract AI01-76ET12548. 55p. (JPL-PUB—80-99). NTIS, PC A04/MF A01.

A contemporary underground coal mine in eastern Kentucky was assessed in order to determine potential off-site and on-site environmental impacts associated with the mining system in the given environmental setting. A 4-section, continuous room-and-pillar mine plan was developed for an appropriate site in eastern Kentucky. Potential environmental impacts were identified, and mitigation costs determined, using an environmental assessment methodology for coal extraction systems developed by Sullivan et al., 1980 (JPL Publication 79-82). The major potential environmental impacts were determined to be: (1) acid water drainage from the mine and refuse site, (2) uneven subsidence of the surface as a result of mining activity, and (3) alteration of ground-water aquifers in the subsidence zone. In the specific case examined, the costs of environmental impact mitigation to levels prescribed by regulations would not exceed $1/ton of coal mined, and post-mining land values would not be affected.

10186 (DOE/EV—0131) **Land reclamation research.** (Argonne National Lab., IL (USA)). Sep 1980. Contract W-31-109-ENG-38. 15p. NTIS, PC A02/MF A01.

The United States Department of Energy has assigned its Office of Environment the task of developing methods that will prevent or reduce damages caused by surface mining. Before that task can be accomplished, more must be learned about the functioning of organisms and their surroundings-the ecosystems threatened by disruptions from surface mining. While new federal and state laws require the full reclamation of mine sites, there is no assurance now that reclaimed areas can be self-sustaining, especially in the arid and semiarid West. To these ends, the Ecological Research Division within the Office of Health and Environmental Research of the Department's Office of Environment has begun a number of related programs aimed at understanding more clearly soils, plants, animals, and other components of the ecosystem so that ways may be found to improve environmental quality or to prevent damage from mining. Another aim is to produce efficient and cost-effective techniques for returning to productive use land that has been scarred by mining. Two national laboratories and six universities carry out these research programs. The work extends from broadly based studies, such as the effects of mining on the hydrologic balance, to very specific studies, such as evaluation of the reproductive cycle of a native grass.

10187 (DOE/EV/70003—11) **Achieving revegetation standards on surface mined lands.** Sindelar, B.W. (Montana State Univ., Bozeman (USA). Dept. of Animal and Range Sciences). 1980. Contract AT06-76EV70003. 27p. (CONF-8003128—1). NTIS, PC A03/MF A01.

From Soil Conservation Society of America symposium on adequate reclamation of mined lands; Billings, MT, USA (26 Mar 1980).

Standards for revegetation success on surface mined lands have been developed by federal and state regulatory authorities. Because reclamation science is young, its potential for meeting revegetation standards is untested. This paper reviews the Montana revegetation standards which require establishment of a diverse, effective, and permanent vegetational cover. In addition, productivity, cover, and diversity must be comparable to that of reference areas. Fifty-one percent of the cover must be of native species. A plant succession study at Colstrip, MT, has been directed toward documenting establishment, succession, and stability of vegetation on surface mined land. Data from the study were used to discuss success of reclamation seedings since 1969. Major problem areas identified include achieving: comparable life form composition, cover of perennial vegetation, species diversity, and seasonality of forage and browse. Achieving erosion control, comparable production, and native species dominance did not appear to be major problems. Achieving revegetation standards on mined lands in the future will require very specialized reclamation procedures and continued research. Naturally revegetated mined lands at Colstrip indicate good potential for reclamation success.

10188 **(DOE/EV/73002—1(Vol.1)) Alaska Regional Energy Resources Planning Project. Phase 2: coal, hydroelectric and energy alternatives. Volume I. Beluga Coal District Analysis.** Rutledge, G.; Lane, D.; Edblom, G. (Alaska State Div. of Energy and Power Development, Anchorage (USA)). 1980. Contract AT06-77EV73002. 452p. (DEPD—81-001-1). NTIS, PC A20/MF A01.

This volume deals with the problems and procedures inherent in the development of the Beluga Coal District. Socio-economic implications of the development and management alternatives are discussed. A review of permits and approvals necessary for the initial development of Beluga Coal Field is presented. Major land tenure issues in the Beluga Coal District as well as existing transportation routes and proposed routes and sites are discussed. The various coal technologies which might be employed at Beluga are described. Transportation options and associated costs of transporting coal from the mine site area to a connecting point with a major, longer distance transportation made and of transporting coal both within and outside (exportation) the state are discussed. Some environmental issues involved in the development of the Beluga Coal Field are presented. (DMC)

10189 **(RM—10) Reclamation of surface-mined lignite spoil in Texas.** Hossner, L.R. (ed.). (Texas Agricultural Experiment Station, College Station (USA); Texas A and M Univ., College Station (USA). Center for Energy and Mineral Resources). 1978. 58p. TIC.

Extensive lignite deposits are located in the Gulf Coast region of Texas. Much of the lignite is near enough to the surface to be removed by conventional surface mining techniques. Other characteristics of the region which should make reclamation programs successful if proper management techniques are used include the following: overburden material is primarily unconsolidated sands and shales; the lignite area of Texas lies within the temperate zone; average annual rainfall varies from about 20 inches in the southwestern part to about 45 inches in the northeastern part of the lignite area. A long growing season coupled with moderate annual temperatures (64 to 70°F) and adequate rainfall give conditions that are suitable for establishment of vegetation on leveled mine spoil. Native soils overlying the lignite are generally infertile; commonly have surface textures of sandy loam or loamy sand; and are highly responsive to management. Soils in the claypan region, which cover much of the lignite northeast of the Colorado River, are shallow, slightly acid, sandy loams underlain by dense clay subsoils. These soils are some of the least productive in Texas. Various revegetation experiences are given.

10190 **(UCID—18931) Environmental control aspects of in situ coal gasification: ground-water quality changes and subsidence effects.** Mead, S.W. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Feb 1981. Contract W-7405-ENG-48. 8p. NTIS, PC A02/MF A01.

Research progress for FY 1980 is reported. The effects of in situ coal gasification (now called Underground Coal Gasification - UCG) on ground water quality are being investigated. The subsurface ground movement and surface subsidence associated with UCG are also being studied. Measurements show that organic contaminants are concentrated in a shell just outside the burn boundary. (ACR)

0110 Reserves And Exploration

REFER ALSO TO CITATION(S) 10188, 10227

10191 **(DOE/MC/11729—T1) Coal studies: methane content of Utah coals; observations on the Sunnyside coal zone; chemical analyses of coal from the Blackhawk formation, Wasatch plateau Coal Field, Carbon, Emery, and Sevier counties, Utah. Special studies 49.** Doelling, H.H.; Smith, A.D.; Davis, F.D.; Hayhurst, D.L.; Hatch, J.R.; Affolter, R.H. (Utah Geological and Mineral Survey, Salt Lake City (USA)). Aug 1979. Contract FG21-79MC11729. 117p. NTIS, PC A06/MF A01.

Three articles on coal deposits in Utah have been entered individually into EDB and ERA. They deal with the methane content, degassing and the chemical composition of the coals and ashes. (LTN)

10192 (DOE/MC/11729—T1, pp 1-43) **Methane content of Utah coals.** Doelling, H.H.; Smith, A.D.; Davis, F.D. Aug 1979.

In Coal studies: methane content of Utah coals; observations on the Sunnyside coal zone; chemical analyses of coal from the Blackhawk formation, Wasatch plateau Coal Field, Carbon, Emery, and Sevier counties, Utah. Special studies 49.

164 core samples from 7 of the more important coal fields in Utah were collected to test their gas contents by the direct method. The greater gas contents appear to be restricted to coals of high volatile A or B rank, but inadequate number of lower ranked coals have been sampled. Utah has no coals of higher rank. Actual gas contents and gas desorption as tested appear to be influenced by the distance from outcrops, or mined areas; by the nature of the encasing rock, and by the physical makeup of the coal itself. Book Cliffs coal field tests normally produced the most gas, but only this field has been adequately tested. Aeromagnetic contours superimposed over the Book Cliffs interestingly coincide with the areas of gassy coals, but no connection between the phenomena can be proven. The adjacent Wasatch Plateau coals appear to desorb minor amounts of gas.

10193 (DOE/MC/11729—T1, pp 44-68) **Observations on the Sunnyside Coal Zone, Utah.** Doelling, H.H.; Smith, A.D.; Davis, F.D.; Hayhurst, D.L. Aug 1979.

In Coal studies: methane content of Utah coals; observations on the Sunnyside coal zone; chemical analyses of coal from the Blackhawk formation, Wasatch plateau Coal Field, Carbon, Emery, and Sevier counties, Utah. Special studies 49.

A marked dissimilarity in methane drainage from horizontal drill holes in two contiguous mines in the Sunnyside coal zone has been noted. A detailed coal bed study was undertaken in an effort to find an explanation. Along with a detailed study of coal bed characteristics, numerous samples were taken for analysis and a large amount of contributed data was studied and provided comment on the Sunnywide zone both locally and regionally concerning deposition, areal extent, physical characteristics, thickness and quality. The difference in degasification of the coal in the two mines was not sufficiently explained. The best observation indicates that parts of coal beds are more permeable than others and allow greater drainage of gas from horizontal drill holes.

0120 Mining

10194 (CONF-800334—(Vol.1), pp 570-589) **Anthracite mining: environmental considerations past, present and future.** Mutchler, N.E.; Miller, R.M. (Berger Associates, Inc., Harrisburg, PA). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

An estimated 200 quads of potential energy lie essentially unused within close proximity to the densely populated and highly

industrialized northeastern United States. The 1917 anthracite production of 100 million tons declined to 5.7 million tons last year. Both traditional and improved mining techniques must interact with the Region's abandoned mine conditions and current laws/regulations. The major environmental problem relating to both active and abandoned mining involves water. Area streams have been adversely impacted chiefly by acid mine drainage discharges from abandoned deep mine/mine pools, followed by AMD sources from coal refuse banks and abandoned surface mines. The deep moving pit mining concept would entirely mine out some of these large colliery underground mines of the past 100 years, thus eliminating at least some large pollution contributors to area streams. A revitalization of anthracite would also do much to reclaim abandoned coal mined land, along with the ten year old Pennsylvania Scarlift Program, and the emerging OSM, SCS, and State Abandoned Mine Land Program under Title IV of the Federal Act, P.L. 95-87. If the FBC demonstration projects are successful, they should provide a source of energy while somewhat reducing the large quantities of coal refuse from past mining. An estimated 60 percent would still remain in the form of ash, requiring new utilization or disposal practices. Continued reclaiming of coal refuse, mainly for power production, along with the use of reject material for subsidence control will also help reduce this blight on the region. Air pollution problems associated with active mining are not great and relate to fugitive dust in surface mining and wind blown silt from slurry ponds. More serious problems relate to nauseous and possible lethal gases from abandoned burning mine fires and mine refuse bank fires.

10195 **(DOE/ET/10577—T2) Work plan for revising the RAMC mine costing methodology.** (McLean Research Center, Inc., VA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA)). 16 Jun 1980. Contract AC01-79ET10577. 30p. (MRC—80-2020-2). NTIS, PC A03/MF A01.

Based on discussions with the Technical Project Officer and current budget constraints, the approach chosen for improving the RAMC mine costing methodology is as follows: Develop a set of regional model mines (both surface and underground) which reflect mining conditions and preference for each major producing district; develop regional equations relating capital and operating costs to various system components; and develop the input data necessary for each estimating relationship. To date, engineering work-ups for all model mines have been prepared, a preliminary surface mine cost model has been developed and steps have been taken to reduce EIA-7 data for use in developing an underground cost model. Descriptions of the surface and underground model mines are contained in Appendices A and B, respectively, and the preliminary surface mine cost model is contained in Appendix C.

10196 **(FE—8924-1) Monorail bridge conveyor. Phase I report, March 31, 1980.** Silks, W. (Goodman Equipment Corp., Chicago, IL (USA)). Mar 1980. Contract AC01-78ET13346. 169p. NTIS, PC A08/MF A01.

This report covers the first phase of a four-phase contract to develop and test a roof hung monorail bridge conveyor coal haulage system working behind a continuous miner. Phase I covers the final design. The original concept presented had to be analyzed before final design could proceed. The analysis revealed that 24 ft. long bridge conveyor segments were the optimum length, the suspension system must have the vertical hinge point between bridges, the impact point of the coal transfer point and the suspension point itself, coincidental. The propulsion system must be such that each bridge is self propelled in order to minimize side loading on the monorail. The conveyor belt drive could be simplified since it only had to drive one single 24 ft. conveyor. The design and detail drawings including MSHA approved enclosures were completed and are ready to be released for Phase II, Fabrication.

10197 **(ICTIS/TR—12) Less-conventional underground coal mining.** Wood, P.A. (International Energy Agency Coal Research, London (UK)). Sep 1980. 85p. NTIS (US Sales Only), PC A05/MF A01.

The recent literature on selected less-conventional and conceptual underground mining methods capable of producing a fragmented coal product is reviewed. Methods covered include auger mining, the use of chain cutters and scraper ploughs, hydraulic mining by monitor jet, hydraulic borehole mining, in-situ chemical comminution, mining systems operated from above ground, and the use of nuclear explosions. The prospects of undersea coal mining are also briefly considered along with various modifications of mining equipment or mine environment. It is concluded that most less-conventional methods would benefit from more research and development, while the conceptual methods should also be seriously considered to ensure coal supplies on the long term.

10198 **(NP—25248) Surface mines in West Virginia.** Welker, D.B.; King, H.M.; Jones, H.L. (West Virginia Geological and Economic Survey, Morgantown (USA)). 1 Oct 1980. 36p. West Virginia Geological and Economic Survey, Morgantown, WV.

The purpose of this publication is to provide a quarterly listing of the nearly 1,000 surface mines in West Virginia. The following information has been included for each mine: a) company name; b) permit number; c) geological unit(s) indicated on mining permit applications; d) mine status; e) location by United States Geological Survey 7 1/2-minute quadrangle; and f) total bonded acreage. Mines listed are those under permit according to the West Virginia Department of Natural Resources, Division of Reclamation. Not listed are prospecting operations, mines which have been grade-released by DNR, or mines for which reclamation bond money has been forfeited. Individual mines are listed alphabetically by company name under their respective county of operation. Those mines extending across county boundaries have been listed under all counties in which they are located.

10199 **Method of mining flat-dipping and sloping beds of a mineral with hydraulic excavation.** Kostovetsky, S.P.; Odinokov, B.P.; Semenikhin, A. Y.; Soin, V.V. US Patent 4,222,612. 16 Sep 1980. Filed date 27 Feb 1978. vp.

The method of mining flat-dipping and sloping beds of a mineral with hydraulic excavation includes dividing the bed being mined into levels and sublevels. The height of the sublevels is determined by the rock geology of the bed formation. The sublevels, in their turn, are subdivided into blocks, the width of each block being short of the limit length of the steady or self-supporting outreach of the cantilever of the rock of the main roof with the given pattern of cutting into the bed with the cutting drifts and holes defining the short working faces. The spacing of the blocks being worked in the upper and lower sublevels in the direction of strata is set to preclude interinfluence of the bearing rock pressure in the blocks where the stoping work is being done. The method enables the conduction of a stable excavation of the mineral over an extended front of stoping.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 10083, 10117, 10165, 10166, 10196, 10224, 11127

10200 **(DOE/PC/30140—T2) KVB coal desulfurization process development. Quarterly technical progress report, October-December 1980.** (Research-Cottrell, Inc., Somerville, NJ (USA)). 1980. Contract AC22-80PC30140. 29p. NTIS, PC A03/MF A01.

This is the second technical progress report for the KVB Coal Desulfurization Process Development. The project is a joint venture between Research-Cottrell, Inc. and the College of Engineering of Rutgers University. The process involves oxidation of the sulfur in coal (both organic and pyritic) to soluble forms using nitrogen oxide gas mixtures and subsequent extractive removal. Key features of the process are mild reaction conditions and the use of a regenerable oxidant. Construction of a bench scale oxidation reactor system was completed and a short experimental program was carried out using Illinois No. 6 coal. An investigation of extraction reagents was also conducted. The emphasis to date has been on development and demonstration of procedures rather than on data generation. However preliminary data do indicate reaction of both organic and pyritic sulfur. Preliminary coal characterization work using x-ray fluorescence is also reported. A brief discussion of project plans in the areas of process modelling and commercial evaluation is also given.

10201 **(IS—4757) Fossil energy annual report, October 1, 1979-September 30, 1980.** (Ames Lab., IA (USA)). Dec 1980. Contract W-7405-ENG-82. 176p. NTIS, PC A09/MF A01.

This report covers objectives and progress for areas of the Ames Laboratory Fossil Energy Program. The period covered is October 1, 1979 through September 30, 1980. Of particular interest are the development of leaching procedures in the Ames wet oxidation process for desulfurizing coal, the cleaning and recovery of coal fines by flotation and oil agglomeration, the systematic study of organic sulfur compounds in coal and the study of the behavior of specific organic sulfur compounds chosen as structural models for the sulfur compounds in coal. (LTN)

10202 **(RI-PMTC—9(80)) Performance characteristics of coal-washing equipment: Baum and Batac jigs. Report of investigation.** Killmeyer, R.P. Jr. (Department of Energy, Pittsburgh, PA (USA). Pittsburgh Mining Technology Center). Oct 1980. 42p. NTIS, PC A03/MF A01.

The profitable operation of a coal preparation plant under today's stringent product standards and ever-rising costs requires that the preparation engineer continually strive for maximum recovery of salable coal. Reliable performance data are a prerequisite to the design of a new plant or to the expansion of existing facilities, and they serve as a yardstick with which the engineer may measure the performance of his plant. With these data and a washability analysis of the raw coal, the preparation engineer can make a rational choice of cleaning equipment. Also, actual, unbiased performance data gathered on the various unit operations from commercial plants are necessary in designing computer models that accurately simulate coal preparation operations. To obtain such performance data, the Coal Preparation Division of DOE's Pittsburgh Mining Technology Center has conducted equipment performance studies of the principal coal cleaning devices used in the United States. In this study three coarse-coal Baum jigs and two fine-coal Batac jigs were evaluated, in commercial coal preparation facilities, to determine typical cleaning performance. The Baum jigs effected good separations on 6-inch by 14-mesh coal at specific gravities of separation between 1.58 and 1.61; the distribution curves drawn for these devices yielded probable errors ranging from 0.087 to 0.161, and error areas from 64 to 95. The Batac jigs made comparable separations in treating 3/4-inch by 200-mesh coal at 1.75 and 1.82 specific gravities of separation; the respective probable errors were 0.123 and 0.109, and the respective error areas were 76 and 87.

10203 **Method and apparatus for producing hardened carbonaceous agglomerates.** Wasson, G.E. (to Conoco Inc). US Patent 4,221,370. 9 Sep 1980. Filed date 16 Apr 1979. vp.

An improved method and apparatus for producing hardened carbonaceous agglomerates from a feedstock selected from the group consisting of finely divided coal solids, finely divided coal-derived solids and hydrocarbonaceous binders is disclosed.

10204 **Flotation of oxidized coal with a latex emulsion of sodium polyacrylate used as a promoter.** Finch, R.E. (to Nalco Chemical Co). US Patent 4,222,862. 16 Sep 1980. Filed date 6 Oct 1978. vp.

A method and treating agent for increasing the yield of oxidized coal or coal from surface or strip mines where said coal particles are concentrated by froth flotation. The method consists of utilizing as a promoter or frothing aid about 05-1.5 lbs of sodium polyacrylate latex per ton of dry coal (0.017-0.5 lb of dry sodium polyacrylate per ton of dry coal), having an average molecular weight of about 100,000 to 1,000,000 and more, with a preferred range of 1,000,000 or more. The preferred promoter or frothing aid for oxidized coal is a water-in-oil latex of sodium polyacrylate and preferably used with an alcohol-type frother. The latex may be utilized neat and self inverts with the assistance of an oil-in-water surfactant hydrophilic (Or activator) and the water in the system upon application to form an oil-in-water emulsion, or it may be used as a two-part system with an activator (Aqueous) to promote inversion. The latex emulsion has demonstrated superiority as a flotation promoter for oxidized coal over the dry polymer and exhibits synergism over the dry polymer and over the components of the latex emulsion including a paraffin solvent, a hydrophobic emulsifier such as sorbitan monooleate, a solvent such as espersol 3-e (Charter; an aromatic blend) and stabilizers such as polyisobutylene and aluminum tristearate.

10205 **Treatment and recovery of larger particles of fine oxidized coal.** Finch, R.E. (to Nalco Chemical Co). US Patent 4,222,861. 16 Sep 1980. Filed date 8 Jun 1978. vp.

This invention relates to a method and treating agent for increasing the yield of larger particles of fine oxidized coal where the particle size is 28 X 100 mesh and preferably 28 X 70 mesh and where said coal particles are concentrated by froth flotation. The method consists of utilizing as a promoter an alkali metal or ammonium polyacrylate. A preferred promoter is about 0.05-1.5 lbs of sodium polyacrylate latex per ton of dry coal (0.017-0.5 lb of dry sodium polyacrylate per ton of dry coal), having an average molecular weight of about 100,000, to 1, 000,000 and more, with a preferred range of 1,000,000 or more. This preferred promoter or frothing aid for oxidized coal is a water-in-oil latex of sodium polyacrylate used with a water-inoil emulsifier and preferably used with an alcohol-type frother. The latex may be utilized neat and self inverts with the assistance of an oil-in-water surfactant and the water in the system upon application to form an oil-in-water emulsion, or it may be used as a two part system with an activator (Aqueous) to promote inversion. Additionally, the latex emulsion recovers larger particles in the size 100 mesh and greater and preferably in the range 28 X 70 mesh.

10206 **Coal cleaner.** Garland, T.F. (to Garland Manufacturing Co). US Patent 4,222,867. 16 Sep 1980. Filed date 23 Feb 1979. vp.

An apparatus for cleaning coal of extraneous matter such as gravel and the like includes a stratifying and classifying oscillating screen submerged in a liquid confining tank wherein stratification is produced by motion of the oscillating screen. The screen bottom slopes downwardly and water flow is induced from either end of the screen to aid in the stratification. The coal which rises to the top is removed by several skimmers powered by a vacuum controlled materials handling pump.

10207 **Apparatus for loosening frozen coal in hopper cars.** Kirwan, G.B. (to Baltimore And Ohio Railroad Co; Chesapeake And Ohio Railway Co). US Patent 4,221,521. 9 Sep 1980. Filed date 16 Jan 1978. vp.

Frozen lumps of coal in conventional hopper cars are loosened by lowering an assembly of vertically oriented probe elements into the car while simultaneously vibrating the assembly. The vibratory structure is mounted on a gantry arrangement which also supports a supplemental probe arrangement utilizing impact forces to loosen coal in hopper cars having interiors different from those of the cars operated on by the vibratory arrangement.

10208 **Experimental measurement of accelerated erosion in a slurry pot tester.** Tsai, W.; Humphrey, J.A.C.; Corner, I.; Levy, A. (Univ of Calif, Berkeley). pp 9-16 of Polyphase flow and transportation technology. New York, NY; ASME (1980).

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

An apparatus is described and experimental measurements are reported for the accelerated erosion testing of three steel alloys by coal and silicon carbide suspensions in kerosene. The measurements are correlated on the basis of dimensional analysis considerations, with empirical constants in the correlation determined through least squares polynomial regression of the data. The high speed nature of the tests yields results which are essentially independent of viscous effects in the present configuration. Various observations related to the fluid mechanics, temperature and water content of the particle suspension are discussed. 13 refs.

0140 Combustion

10209 **(ANL/CEN/FE—80-8) Exploratory and basic fluidized-bed combustion studies. Quarterly report, January-March 1980.** Johnson, I.; Myles, K.M.; Swift, W.M. (Argonne National Lab., IL (USA)). Dec 1980. Contract W-31-109-ENG-38. 40p. NTIS, PC A03/MF A01.

This work supports development studies for both atmospheric and pressurized fluidized-bed coal combustion. Laboratory and process development studies are aimed at providing needed information on limestone utilization, removal of particulates and alkali metal compounds from the flue gas, control of SO_2 and trace pollutants emissions, and other aspects of fluidized-bed combustion. This report presents information on: (1) the development of a limestone utilization predictive methodology, (2) studies of particle breakup and elutriation, (3) basic studies on limestone sulfation enhancement by hydration, (4) studies of the kinetics of the hydration process, and (5) an investigation of various hydration process concepts.

10210 **(ANL/CEN/FE—80-13) Application of noncatalytic gas-solid reactions for a single pellet of changing size to the modeling of fluidized-bed combustion of coal char containing sulfur.** Rehmat, A.; Saxena, S.C.; Land, R.H. (Argonne National Lab., IL (USA)). Sep 1980. Contract W-31-109-ENG-38. 84p. NTIS, PC A05/MF A01.

A mechanistic model is developed for coal char combustion, with sulfur retention by limestone or dolomite sorbent, in a gas fluidized bed employing noncatalytic single pellet gas-solid reactions. The shrinking core model is employed to describe the kinetics of chemical reactions taking place on a single pellet; changes in pellet size as the reaction proceeds are considered. The solids are assumed to be in back-mix condition whereas the gas flow is regarded to be in plug flow. Most char combustion occurs near the gas distributor plate (at the bottom of the bed), where the bubbles are small and consequently the mass transfer rate is high. For such a case, the analysis is considerably simplified by ignoring the bubble phase since it plays an insignificant role in the overall rate of carbon conversion. Bubble-free operation is also encounterd in the turbulent regime, where the gas flow is quite high and classical bubbles do not exist. Formulation of the model includes setting up heat and mass balance equations pertaining to a single particle (1) exposed to a varying reactant concentration along the height of the bed and (2) whose size changes during reaction. These equations are then solved numerically to account for particles of all sizes in the bed in obtaining the overall carbon conversion efficiency and resultant sulfur retention. In particular, the influence on sorbent requirement of several fluid-bed variables such as oxygen concentration profile, particle size, reaction rate for sulfation reaction, and suflur adsorption efficiency are examined.

10211 **(ANL/CEN/FE—80-14) Fluidized-bed combustion process evaluation and program support. Quarterly report, January-March 1980.** Johnson, I.; Podolski, W.F.; Swift, W.M.; Henry, R.F.; Hanway, J.E.; Griggs, K.E.; Herzenberg, C.; Helt, J.E.; Carls, E.L. (Argonne National Lab., IL (USA)). Dec 1980. Contract W-31-109-ENG-38. 38p. NTIS, PC A03/MF A01.

Argonne National Laboratory is undertaking several tasks primarily in support of the pressurized fluidized-bed combustion project management team at Morgantown Energy Technology Center. Work is under way to provide fluidized-bed combustion process evaluation and program support to METC, determination of the state of the art of instrumentation for FBC applications, evaluation of the performance capability of cyclones for hot-gas cleaning in PFBC systems, and an initial assessment of methods for the measurement of sodium sulfate dew point.

10212 **(ANL/EES-TM—117) Pulse combustion technology for heating applications. Quarterly progress report, July 1-September 30, 1980.** Blomquist, C.A.; Clinch, J.M.; Egbert, H.P. (Argonne National Lab., IL (USA)). Nov 1980. Contract W-31-109-ENG-38. 23p. NTIS, PC A02/MF A01.

The primary purpose of this research program is to develop and expand the technology base for fossil-fuel-fired pulse combustion heating systems. A major goal is to develop design data and design procedures for pulse combustion burners. This design capability will contribute to the accelerated industrial development of cost-effective, high-efficiency systems for a variety of heating applications. A series of parametric experiments will be conducted with ANL's existing experimental pulse combustor. Basic performance characteristics, including heat-transfer rates, thermal efficiency, noise emissions, and exhaust-gas composition, will be obtained as a function of the primary combustor-design parameters, including combustor geometry, fuel/air ratio, valve geometry, and decoupling chamber size. Experimental data acquired will be analyzed and correlated in a manner suitable for engineering design of gas-fired pulse combustors. Based on these data and correlations, a mathematical model of the combustor will be developed for use as an engineering design tool in establishing combustor geometry for specific applications and for defining trade-offs between system efficiency, noise emissions, and cost. Noise and pressure-fluctuation data will be characterized in detail and analyzed with respect to frequency and amplitude. These analyses will be employed to develop specific design strategies for noise suppression. Preliminary experimental and analytical investigations will be initiated to develop a basis for extendng the pulse combustion concept to liquid- and solid-fuel-burning systems.

10213 **(DOE/ET/10415—T2) Development of potential uses for the residue from fluidized bed combustion processes. Quarterly technical progress report, September-November 1980.** Minnick, L.J. (Minnick (L.J.), Inc., Plymouth Meeting, PA (USA)). 1980. Contract AC21-77ET10415. 28p. NTIS, PC A03/MF A01.

Conclusions from this quarter's work are: There has been a gradual increase in the loss on ignition of samples of stockpiled AFB residue. The probable cause is carbonation due to the presence of free calcium oxide. Separating AFB residue into two fractions by use of a mineral cyclone did not produce a lime rich fraction. A stockpiled mixture of crushed stone and AFB residue became moderately cemented within three months. The presence of excess water appears to accelerate the cementitious reaction. Synthetic aggregate produced by briquetting exhibits aggregate properties which appear to be comparable to lightweight aggregate. Masonry units containing AFB residue can be successfully made under normal production conditions in a commercial block plant. Road base mixes containing less than 10% AFB residue develop satisfactory compressive strengths (up to 2100 psi in 28 days). The expansion of grout slurry mixes can be varied by adjusting the composition of the mix.

10214 **(DOE/ET/13152—5) Measuring and modeling solids movement in a large, cold fluidized-bed test facility. Fifth quarterly report for the period October 1, 1980-December 31, 1980.** Fitzgerald, T.J.; Mrazek, R.V.; Crane, S.D. (Oregon State Univ., Corvallis (USA)). Dec 1980. Contract AC01-79ET13152. 181p. NTIS, PC A09/MF A01.

One part representing work on the development and testing of a flowmeter for measuring the motion of solids in a fluidized bed and the second part (a Ph. D. Thesis) on the plume model of fluidized-bed combustion of coal, including its development and validation, have been entered individually into EDB and ERA. (LTN)

10215 (DOE/ET/13152—5, pp 1-26) **Magnetic solids flow meter.** Dec 1980.

In Measuring and modeling solids movement in a large, cold fluidized-bed test facility. Fifth quarterly report for the period October 1, 1980-December 31, 1980.

Previous reports have presented tests which show that the magnetic mass flow meter developed at OSU to study the movement of solids in a fluidized bed is capable of reproducibly measuring the mass flow of magnetic solids. A test apparatus was used to measure the velocity of circulating loops of magnetic solids, and the results showed that the response was directly proportional to both the linear velocity, and the cross-sectional area of the loop; thus the overall response is proportional to the mass flux. Before the device can be used to give unambiguous results in an operating fluidized bed, three tasks remain. They are: Shortening the response time between the application of the magnetizing pulse and the measuring of the induced voltage caused by the motion of the magnetized solids; eliminating flow obstructions which could affect the velocity of solids in the vicinity of the pickup coil; and eliminating to the greatest extent possible the errors produced by the passage of bubbles. Two modifications which shorten the response time have already been made, and the response time will be shortened even more by the use of a new probe which has the added benefit of eliminating the presence of flow-obstructing coils external to the

in-bed tubes. The new probe should also reduce errors caused by the passage of bubbles.

10216 (DOE/ET/13152—5, pp 1-150) **Plume model for large utility scale atmospheric fluidized bed combustors.** Park, D. (Oregon State Univ., Corvallis). Dec 1980.

In Measuring and modeling solids movement in a large, cold fluidized-bed test facility. Fifth quarterly report for the period October 1, 1980-December 31, 1980.

A well designed AFBC should: Minimize the loss of unburned fuel, i.e., maximize combustion efficiency; minimize the release of pollutants; operate with a minimum of excess air to reduce the load on the blower and to maximize thermal efficiency; and maximize the utilization of limestone for sulfur dioxide retention to minimize the cost on limestone and solid waste disposal problem. These are competing requirements. To evaluate the tradeoffs involved in different AFBC designs it is necessary to have a model to correlate the variables and to predict the performance of the bed. The models on the AFBC published in the literature have been studied. The assumptions are tabulated, compared to observations and checked to see if they are useful for the large utility scale AFBCs. The plume model is then formulated. The unique feature of the plume model is that it naturally explains that there exist radial variations of gas concentration in the bed. Models published in the past are one dimensional: they consider only the vertical variation or only the radial variation. The plume model gives a three dimensional picture of the bed using cylindrical coordinates. The plume model also implies that there are regions in the bed which are in a reducing environment, that these plumes are devoid of oxygen, are not stationary but fluctuate like the plumes from smoke stacks. The plume model also predicts a temperature jump above the bed which rises with increasing spacing of feed ports. This was indeed observed in the Babcock and Wilcox pilot plant. For the sulfur retention efficiency the plume model tells us the importance of the devolatilization of sulfur and its subsequent behavior.

10217 (DOE/ET/15166—T2) **Continuing development of regenerable sorbents for fluidized-bed combustion. Semiannual technical progress report No. 2, April 1-September 30, 1980.** Kalfadelis, C.D. (Exxon Research and Engineering Co., Linden, NJ (USA)). 1980. Contract AC21-79ET15166. 37p. NTIS, PC A03/MF A01.

Our efforts were directed primarily to preparation for and/ the initial operation of the laboratory-scale hot fluidized bed test system (LSHFB). The initial test sequence in the LSHFB system was performed with a fixed-bed of 100 grams of barium titanate synthetic sorbent. The sorbent bed was alternately sulfated and regenerated five times. Sulfation was accomplished at 900°C, with a synthetic flue gas mixture comprising 10.1% CO_2, 4.95% O_2, 0.2435% SO_2 and 84.7% N_2. Regeneration was performed at 1025°C with a gas containing 8.0% CO and 92.0% N_2. After an initial drop in sulfation performance after the first sulfation/regeneration cycle, performance held steady, or was shown to be improving, during the succeeding four cycles. Although the initial operation of this system proceeded relatively smoothly, the reactor was found to have been irreparably damaged by the end of the initial test sequence. A new reactor was subsequently designed, fabricated, and installed in the unit. Concurrently, sorbent pellet preparation by extrusion was investigated in the Catalyst Preparation Facility at the Baton Rouge Laboratory of Exxon Research and Engineering Company. Preparation of sorbent pellets for use in the LSHFB operation was continued on a laboratory-scale at Linden throughout the reporting period. Cost and time estimates were prepared for operation of the bench-scale fluidized bed coal combustion and regeneration facilities, including preparation of the requisite volumes of synthetic sorbent pellets needed for that program.

10218 (DOE/PC/30295—1) **Kinetics of NO/sub x/ formation during early stages of pulverized coal combustion. First quarterly report, 26 September 1980-28 December 1980.** Krill, W.V.; Chu, E.K.; Tong, H. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.). 30 Jan 1981. Contract AC22-80PC30295. 18p. NTIS, PC A02/MF A01.

The first quarter results under the Department of Energy Contract DE-AC22-80PC-30295 are reported. A stirred reactor technique to simulate the early combustion environment of coal particles has been devised. An existing cold flow model has been modified to develop the operating conditions required for combustion experiments. A test matrix for the cold flow tests has been developed and the system readied for testing. The anticipated analytical measurement approaches to the combustion test phases of the program are also discussed. An initial reported set of gas phase reactions has been incorporated into the PROF code. Predictions of NO/sub x/ formation to date have exhibited good agreement with existing combustion data. Experimental data of thermal NO/sub x/ formation in the stirred reactor will be integrated with the kinetic model.

10219 (DOE/PC/30296—1) **Advanced pulverized coal combustor for control of NO/sub x/ emissions. First quarterly report, September 24-December 24, 1980.** Pam, R.; Chu, E.K.; Kelly, J.T. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.). 30 Jan 1981. Contract AC22-80PC30296. 51p. NTIS, PC A04/MF A01.

The first quarter results under the Advanced Pulverized Coal Combustor for Control of NO/sub x/ Emissions Program (DOE Contract DE-AC22-80PC30296) are reported. A preliminary gas phase reaction model for predicting fuel NO/sub x/ formation during combustion of methane fuel has been constructed. Predictions of NO/sub x/ formation under stirred reactor conditions agree with existing experimental data. Thermal NO/sub x/ and coal reaction data will be developed and verified during the next reporting period. Progress has been made in formulating the changes necessary to upgrade the Acurex PROF code for use as the comprehensive data analysis tool in this program. The radiation modeling and the incorporation of the needed modifications into the PROF code will occur during the next reporting period. The idealized combustor was designed, and requests for bids to fabricate the combustor were submitted. Combustor fabrication will be completed during the next reporting period.

10220 (DOE/PC/30297—T1) **Assessment of pulverized coal-fired combustor performance. First quarterly technical progress report.** Richter, W.; Clark, W.; Payne, R. (Energy and Environmental Research Corp., Santa Ana, CA (USA)). Jan 1981. Contract AC22-80PC30297. 26p. NTIS, PC A03/MF A01.

The objective of this program is to provide the engineering tools necessary for an authoritative assessment of the performance of industrial furnaces firing pulverized coal. The program incorporates two experimental tasks and is constructed around an analytical task which will identify and upgrade the family of computer programs required to undertake the performance analysis studies. These analytical tools will be used to predict the effect of parameters such as fuel type and furnace variables on combustor performance, and to identify those properties which have a major impact on thermal performance. The second task uses a combustion reactor to screen the key variables identified and to provide data on the properties of coal particulate matter which affect heat transfer performance. Verification of the engineering analytical approach will be provided by measurements made in a pilot-scale furnace. This present report discusses technical progress during the first three months of the program, and considers the selection of the appropriate analytical tools and preliminary details of the experimental system.

10221 (DOE/PC/30301—1) **CaO interactions in the staged combustion of coal. First quarterly technical progress report for the period September 23-December 31, 1980.** Levy, A.; Merryman, E.L. (Battelle Columbus Labs., OH (USA)). 30 Jan 1981. Contract AC22-80PC30301. 19p. NTIS, PC A02/MF A01.

It is widely recognized that alkaline oxides, especially CaO, can be most effective in capturing sulfur in-situ. It is equally well recognized that NO/sub x/ emissions due to fuel-bound nitrogen in coal can be effectively minimized with staged combustion. Both these aspects have been demonstrated separately at Battelle and other laboratories. It is the overall objective of this program to develop the basis for optimizing sulfur capture by CaO under staged combustion. Our approach to accomplishing this goal is via an experimental and interpretative study of the chemistry and interac-

tions of CaO under simulated and actual staged combustion conditions. In staged combustion one fires first under reducing (fuel rich) conditions prior to oxidation in the second stage. Our studies wherein coals were treated with CaO, i.e., impregnated with CaO for pulverized coal firing, or mixed and pelletized with CaO for stoker firing, suggest that conditions prevail under which CaO is first converted to CaS prior to being oxidized to $CaSO_4$. Since CaS has a greater thermal stability than $CaSO_4$, it is therefore possible to fire at temperatures above 900°C (1650°F) and retain sulfur under proper stoichiometric conditions. The program is aimed at defining the chemistry and combustion kinetics necessary to optimize the sulfur capture with the ultimate application of reducing SO_2 and NO/sub x/ in the firing of pulverized coal.

10222 **(DOE/PC/30302—1) Synthetic fuel aromaticity and staged combustion. First quarterly technical progress report, September 23-December 31, 1980.** Levy, A.; Longanbach, J.R.; Chan, L.K. (Battelle Columbus Labs., OH (USA)). 28 Jan 1981. Contract AC22-80PC30302. 21p. NTIS, PC A02/MF A01.

Synthetic liquid fuels, otherwise referred to as synfuels or coal-derived liquids, are probably best characterized from a combustion-environmental point of view as low in hydrogen, low in sulfur, high in nitrogen, and high in aromatics. As a consequence two of the more critical problems in synfuel combustion are NO/sub x/ formation and soot formation (and polycyclic organic matter). This program is directed to these two issues. At first hand the solutions to burning synfuels high in aromatics and fuel-bound nitrogen are diametrically opposed, i.e., high temperature and excess air keep soot levels down, low temperatures and vitiated air keep nitrogen oxide levels down. Staged combustion however offers a logical solution to the above. This program separates and analyzes the synfuel combustion problem via its component parts and then puts them together again phenomenologically via the stage combustion process.

10223 **(FE—1726-46A) Engineer, design, construct, test and evaluate a pressuriized fluidized-bed pilot plant using high-sulfur coal for production of electric power. Phase I. Preliminary engineering.** (Curtiss-Wright Corp., Wood-Ridge, NJ (USA). Power Systems Div.). Feb 1979. Contract AC21-76ET10417. 177p. NTIS, PC A09/MF A01.

The following conclusions resulted from testing the pressurized, fluidized-bed combustor which was designed and constructed: the initial secondary gas clean-up system proved inadequate; elutriation of bed particulate exceeded expectation and specification requirements could not be met; overall heat transfer per tube for the original design 38 OD fin tubes achieved 93% of the pilot plant requirement; regenerative heat transfer through the inner tube assembly was excessive due to deterioration of insulating material; inner fin attachment was between 75 to 80% which contributed to reduced overall heat transfer; heat transfer from bed to cooling air will be improved by pending improvements in tube fabrication techniques; heat loss from combustor vessel and process piping and gas cleanup devices exceeds estimates; EPA limits for gaseous emissions can be readily achieved in the PFBC; PFBC provides excellent combustion characteristics showing 99.9+% efficiency, very uniform bed temperatures and no freeboard burning; and development of coal feed system and hot ash valves resulted in improved reliability and durability through the use of the Technology rig.

10224 **(ORNL—5661) Fuel cycle analysis for fossil energy systems: coal combustion.** Greenstreet, W.L.; Carmichael, R.L. (Oak Ridge National Lab., TN (USA)). Feb 1981. Contract W-7405-ENG-26. 392p. NTIS, PC A17/MF A01.

Elements of the fuel cycle for coal combustion in power generation are examined; and information on economics, technological status, energy efficiencies, and environmental issues is reviewed. Overall background information is provided for guidance in identifying issues and establishing needs and priorities for engineering research, development, and demonstration. The elements treated include mining, transportation, coal preparation, direct combustion, and environmental control technology. The treatment used differs from that of usual compendiums in its emphasis on integrated examination and presentation directed primarily toward providing bases for general assessment and for guidance in program development. Emphasis is on program identification as opposed to advocacy.

10225 **Direct ignition of a fluctuating fuel stream.** Laflesh, R.C.; Smith, D.A. (to Combustion Engineering Inc). US Patent 4,221,174. 9 Sep 1980. Filed date 16 May 1978. vp.

A method of direct ignition of pulverized coal to furnish energy for warm-up or low load operation of a coal burning furnace comprises forming a fuel stream consisting of a mixture of pulverized coal and air, the fuel stream having an air to coal ratio and/or a flow velocity which fluctuates. The fluctuating fluid stream is introduced into a combustion area where the coal is ignited by an energy source. The fluctuation of the air to coal ratio and/or the fluctuation of the flow speed provide for the air to coal ratio and/or the flow speed to be swept through a range of values which includes the optimum conditions for ignition.

0150 Marketing And Economics

10226 **(DOE/EIA/10578—T1) Design change documentation for the National Coal Model.** (McLean Research Center, Inc., VA (USA)). 14 May 1980. Contract AC01-79EI10578. 12p. (MRC—80-2030-1). NTIS, PC A02/MF A01.

Several modifications are to be made to the National Coal Model (NCM) under contract number DE-AC01-79EI-10578. The model will be expanded to include two additional demand regions (increasing the total number of demand regions to 41) and one additional supply region (increasing the total number of supply regions to 31). Implementing this change in the NCM will be very simple. The relevant tables and lists will be expanded to include the new regions, and the dimensionality of all relevant arrays will be increased to 31 or 41, as required. A more difficult task will be to appropriately modify the various input data files to reflect the new regions. This task will be the responsibility of the Coal and Electric Power Analysis Division staff. The model will be modified to use externally-specified transportation rates for each origin/destination pair, rather than the linear transportation cost equations (based on mileage) that are used presently. Thus, an input file of transportation rates (prepared externally to the NCM, as are the coal supply curves) will be used directly to provide transportation rates ($/ton) for each coal type/origin/destination activity (i.e., column) generated in the transportation portion of the matrix generator. Other modifications under consideration relate to model output reports, an industrial boiler fuel model, and price-sensitive non-utility demand.

10227 **(DOE/ET/10577—T1) Interim report on revising the resource allocation and mine costing model.** (McLean Research Center, Inc., VA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA)). 7 Mar 1980. Contract AC01-79ET10577. 80p. (MRC—80-2020-1). NTIS, PC A05/MF A01.

The purpose of this contract is to provide the Coal and Electric Power Analysis Division, EIA, with a revised and fully documented Resource Allocation and Mine Costing (RAMC) model to be used in developing coal supply curves for use in the Mid-range Energy Forecasting System and the National Coal Model. The project is structured in three phases, as follows: establish conceptual underpinnings of revised supply curve methodology; revise mine costing methodology; and revise resource allocation methodology. The first three tasks in Phase I were to review and critique the current RAMC approach, review and critique the NUS deep mine and the Fluor Utah surface mine costing methodologies, and to propose revisions to the current approach. This Interim Report documents our findings under these three tasks. Our review of the current RAMC concludes that the resource allocation methodology is reasonable; however, the mine costing methodology has a number of deficiencies. Hence, Section 5 presents a number of alternative approaches for implementing an improved costing methodology in the RAMC model. Although the resource allocation approach is reasonable, the data used to drive the model need to be improved. The Appendices discuss a number of these data issues, affecting both mine costing and resource allocation.

10228 (DOE/FE—0011) Analysis of the market and product costs for coal-derived high Btu gas: staff working paper. (Department of Energy, Washington, DC (USA). Assistant Secretary for Fossil Energy). Dec 1980. 54p. NTIS, PC A04/MF A01.

The purpose of this paper is to analyze the market and product costs for coal-derived high Btu gas. This analysis is based upon supply and demand projections that reflect the effects of natural gas deregulation, recent large oil price increases, and new or pending legislation designed to reduce oil imports. Product economics are based upon estimates developed by staff of the Office of Plans and Technology Assessment using internal DOE studies and published data. While these data are believed to be representative of the costs to produce high Btu gas from coal using advanced gasification technology that is ready for technical demonstration at commercially relevant scales, they are not based upon detailed design studies. The analysis indicates that an increasingly large market for supplemental gas is expected to open up by 1990 and that high Btu gas from advanced technology is likely to be economically superior to gas imports over a wide range of alternative assumptions. While several studies suggest that there may be a considerable market for MBG, the potential supplemental gas demand is sufficiently large that significant markets will exist for both MBG and HBG from coal. HBG from advanced technology is especially important if synthetic fuels are to be produced in the East, since there is no data available to indicate that current coal gasification technology can economically use the abundant, moderate to highly caking Eastern coals.

10229 (EPRI-AP—1671) Northeast coal utilization program: Phase 2. Final report. (Stone and Webster Engineering Corp., New York (USA)). Jan 1981. 175p. NTIS, PC A08/MF A01.

This report documents the activities of a group of utilities drawn from the northeastern United States. It relates to the introduction of coal liquefaction as a source of the liquid fuel needed for power generation in the region. Coal liquefaction by hydrogenation using the H-Coal, Exxon Donor Solvent, and SRC-II processes is the focus of general studies related to technology and economics, to commercial project development, and to plant siting. Achievement of significant coal liquefaction capacity in place is recognized to be hindered by technical risk and lack of economic incentive as the nation adjusts to the use of heavy, high sulfur crude oils. Against this background, the concept is developed of a convertible plant capable of functioning in both coal liquefaction and in heavy oil upgrading. Construction of a single train coal liquefaction facility based on purchasing hydrogen and other services from an adjacent oil refinery is also considered as a method of introducing first generation coal liquefaction plants at minimum risk. Studies of process configuration show that least cost coal liquids are produced based on hydrogen production by gasification of process residues; purchase of plant power and sale of product gas can improve the economics of coal liquefaction; potential exists for integration of direct (e.g., H-Coal) and indirect (e.g., methanol) methods of coal liquefaction; and coal liquefaction in which distillable, low sulfur liquid products are made appears to be the most economical approach, though scope exists for continued evaluation in this area.

10230 West Germany plans to use more coal. *World Coal* 6: No. 11, 56-57(Nov 1980).

West Germany's economically minable hard coal reserves, to a depth of 1500 meters (5000 feet), are approximately 24,000,000,000 tons. Hard coal mines produced 87,000,000 tons in 1979 and are expected to produce about the same in 1980. Currently, the supply capacity of West Germany's hard coal mines will be more than 90,000,000 tons by 1985, more than 95,000,000 tons by 1990, and well above the 100,000,000-ton level by the year 2000. In order to increase the capacity to an annual production of 100,000,000 tons, a toal investment of about $4,500,000,000 is required. In addition, an investment of more than $1,680,000,000 per year is needed to keep up the existing capacity. There are manpower problems in West German coal mines, but these problems can be solved. Increased mechanization and automation is the goal of current research and development. Efforts to improve working conditions, health protection for miners, and the safety of underground operations are very closely connected with these technological developments. Work is also being done on the development of drilling and blasting techniques and heading machines which can crush rocks with cutters and high pressure jets of water. Mining operations have already attained a high technical level. Coal winning is 100 percent mechanized. Average daily output per working is now close to the 1400-ton mark and productivity has in some cases reached 20 tons per manshift. Efforts are also being made to improve underground transportation and supply techniques since these are still the most labor intensive operations in deep mines. Intensive work is also being done on the development of coal conversion processes. Significant progress has been made and the processes have also been improved. The results achieved are being used as a basis for a demonstration plant currently being built.

0160 Health And Safety

REFER ALSO TO CITATION(S) 10105

10231 (CONF-800334—(Vol.1), pp 616-628) Environmental control systems for the SRC-II demonstration plant. Schmalzer, D.K.; Moxley, C.R. Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

In July 1978, the US Department of Energy and The Pittsburgh and Midway Coal Mining Co., a subsidiary of Gulf Oil Corporation, entered into a contract which has as principal objectives the design, construction, and operation of a demonstration scale SRC-II coal liquefaction plant. A basic precept in this project for both DOE and P and M is that safety, health protection, and environmental acceptability will be dominant considerations in the design and operation of the Demonstration Plant. Application of a wide variety of control technology is planned and under consideration. This paper will briefly describe these areas as well as the employee health protection programs planned.

0170 Legislation And Regulations

10232 (EMD—80-87) Sortfall in leasing coal from Federal lands: what effect on national energy goals. Staats, E.B. (General Accounting Office, Washington, DC (USA)). 22 Aug 1980. 120p. GPO.

Report to the Congress of the United States by the Comptroller General.

In January 1981 - after a 10-year moratorium - the Department of the Interior plans to resume competitive coal leasing. But flaws in the new program, unless corrected early, may greatly reduce the amount of coal available from Federal lands. Interior's plans for the first sale include only about one-third as much coal as needed. Faulty assumptions in setting the leasing target risk a Government-caused production shortfall by the late 1980s. Interior's falure to obtain expressions of leasing interest from industry during land use planning unnecessarily restricts coal development and may force it to less economically and environmentally suitable locations. More data on coal deposits is needed to identify and evaluate tracts and industry needs to be encouraged to do more exploration.

02 PETROLEUM

10233 (DOE/PR/50162—T2) Energy management manual. (Ernst and Ernst, Washington, DC (USA)). Jun 1979. Contract AC01-76PR50162. 264p. NTIS, PC A12/MF A01.

The Jacarilla reservation lies on the San Juan Basin in New Mexico, with vast oil and gas deposits, actively developed since the late 1950s. Constraints on Tribal regulation of energy development are discussed in Section I. Section II describes the relationship between Federal agencies and the Tribe; identifies energy management problems; recommends management activities to address the problems; and points out skill requirements. The Tribe has now adopted a formal statement of goals and objectives for its minerals management program and details of the program are described in Section III. Information on the legal analysis of oil and gas development on the land of the Tribe is given in the appendix. (MCW)

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 10301, 10346, 11591, 11697

10234 (SAND—80-2561) Low invasion fluids for pressure coring. Heckes, A.A.; McFall, A.L.; Delgado, S.M. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 39p. NTIS, PC A03/MF A01.

An experimental investigation was performed on seven different low invasion fluids. The investigation employed commercially available calcium carbonate ($CaCO_3$) materials which were compared using two different sandstone core samples (brown and gray berea) and two simulated field conditions (static and dynamic). Results indicate that the presently used mixture of 10 lb/bbl HEC polymer and 300 lb/bbl $CaCO_3$ in a $CaCl_2$ eutectic brine mixture appears to be a very good choice for minimizing invasion of the core sample. Minor improvements in core invasion are achieved by matching the $CaCO_3$ particle size to the formation pore size. Experimentation or prior experience is necessary for choosing the type of $CaCO_3$ to be used. At best, the invasion of the core may only be slowed and not stopped completely. Factors which cause relatively large amounts of filtrate intrusion into the core are long exposure times, low fluid viscosities, and low solids content of the fluid. Curves demonstrating the effectiveness of high polymer and $CaCO_3$ particle concentrations and comparing the core invasion of water, bentonite drilling mud and the seven low invasion fluids are presented.

10235 Seismic exploration method. Hackett, G.K. (to Union Oil Co of California). US Patent 4,223,399. 16 Sep 1980. Filed date 12 Jul 1978. vp.

A seismic exploration method in which a coded energy signal is generated and transmitted into the earth, the seismic energy reflected from within the earth is sensed and sampled to form a raw trace, the raw trace is crosscorrelated with a record of the coded energy signal, and a predictive operator derived from the autocorrelation function of the coded energy signal is subtractively applied to the crosscorrelated trace to remove correlation residuals, and thereby produce a high quality processed trace. Geophysical principles are used to interpret the processed trace and identify subterranean mineral deposits of interest. Based on this interpretation at least one well is drilled to further explore and/or develop the mineral deposits of interest.

10236 Reservoir fluid sampling method and apparatus . Hollingsworth, F.H.; Mower, L.N. (to Standard Oil Co (Indiana)). US Patent 4,222,438. 16 Sep 1980. Filed date 30 Oct 1978. vp.

Determinations are made of the conditions in a fluid-containing well penetrating a fluid-producing subterranean reservoir by isolating an interval in the well which penetrates the fluid-producing reservoir, withdrawing fluid from the interval and determining conditions such as fluid composition, pressure buildup, and temperature in the interval. The interval is isolated with a packing member surrounding an open conduit means extending in the well from the top of the well to a location adjacent the reservoir. Fluid moves from the reservoir into the conduit means and is withdrawn from the conduit means through an opening in the conduit means above and adjacent the lower end of the conduit means. Determinations are made by lowering measuring tools through the tubing string to a location in the well below the opening through which fluid is withdrawn from the conduit means.

10237 Seafloor diverter. Allen, N.W. (to Standard Oil Co (Indiana)). US Patent 4,220,207. 2 Sep 1980. Filed date 31 Oct 1978. vp.

This relates to drilling in water from a platform or vessel using a riser pipe. An inverted funnel skirt or cone is placed over slots cut in the wall of a riser pipe a short distance above its lower end. The apex end of the cone is welded to the riser pipe above the slots and drill cuttings pass through the slots and fall to the seafloor. Another embodiment includes an "I" shaped diverter flowline welded to the periphery of each hole in the riser pipe with one leg of the "I" extending a short distance below the hole.

0203 Drilling And Production

10238 (ANL/EES-TM—96(Vol.1), pp 447-456) Innovative enhanced oil recovery separations methods. Cravens, J.B. (Rexnord Inc., Milwaukee, WI); Erickson, P.R.; Griffith, W.L.; Compere, A.L. Aug 1980.

From 12. IECEC conference on energy conservation in the treatment of industrial wastewaters; New Orleans, LA, USA (10 Dec 1979).

In enhanced oil recovery procedures, polymers are added to banks injected into oil bearing formations to raise their viscosity above that of the banks they displace, in order to prevent viscous fingering of the displacing banks into those being displaced. Microbial polysaccharides comprise one class of polymers used for this purpose. Whether or not the biopolymer is precipitated prior to field use, separation of biomass from the fermentation broth is a major consideration in polymer quality. On the basis of bench and pilot microscreen tests, microscreening (or microstraining) is a promising separation method. This approach has been successfully used in the field of water and wastewater treatment for the removal of fine solids since the early 1950's. The microscreening process performs a continuous separation of solids from a liquid suspension utilizing a filter media continuously regenerated by backwashing. Bench and pilot tests with Envirex microscreen equipment indicate that it is possible to remove on the order of 4/5 of the influent biomass, as volatile suspended solids, from a high viscosity scleroglucan biopolymer feed stream. It appears that microscreening decreases or obviates the need for high-shear treatment of scleroglucan solutions prior to solids separation. A further advantage of microscreening is the elimination of the biopolymer precipitation and consequent high shear resuspension operations. Biopolymer precipitation is a major energy consuming process in biopolymer preparation since it can account for a solvent loss on the order of a gal of alcohol per lb biopolymer.

10239 (CONF-800334—(Vol.1), pp 481-494) Overview of the status of enhanced oil recovery in the US, and related environmental concerns. Perry, C.W. (Dept. of Energy, Washington, DC); Donaldson, E.C. Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The objective of this paper is to present a brief overview of the status of enhanced oil recovery (EOR) in the US, with particular emphasis on the activities of the DOE Secretariats for Fossil Energy and the Environment. As the activity in EOR expands, due to the economic pressures to produce domestic oil, many new field tests, both developmental and commercial, are getting underway. This involves the use of the newer thermal and chemical techniques which present possible air and water pollution problems. Thus a need to alleviate environmental concerns arises. In the two Secretariats involved, work on EOR environmental problems has been accelerating. The timing of the EOR expansion technically and commercially is such that the necessary environmental planning, although not entirely completed, is adequate and ready. The environmental problems and probable solutions are presented.

10240 (DOE/BC/10032—24) BETC information management system with focus on ROS estimation. Final report. Willoughby, J.K.; Gardner, J.A.; Heath, S.B.; Kehler, M.A. (Science Applications, Inc., Englewood, CO (USA)). Nov 1980. Contract AC19-79BC10032. 106p. NTIS, PC A06/MF A01.

A special-purpose information data base system has been designed by Science Applications, Inc. for the Bartlesville Energy Technology Center to support the technical staff in the areas of Enhanced Oil Recovery (EOR) and Residual Oil Saturation Estimation (ROS). The system has been built by a multidisciplinary team of designers combining a series of iterative design steps and pilot software development tasks to produce a unique information retrieval system. Studies of information usage patterns and information perceptions by BETC terms (i.e., a subject taxonomy) emphasizing EOR/ROS and its related subject domain. The analysis of usage patterns also revealed that four basic data types were required most often by potential system users. These were: (1) numeric files; (2) bibliographic citations and abstracts; (3) project information such as schedules and budgets; and (4) references to per-

sons that were authorities in various relevant topical areas. The need for a unique subject taxonomy and for four different data types resulted in the design of a system that will permit the retrieval of information by searching the subject taxonomy, selecting a subject term, or terms, and determining the appropriate data types in one-step searching. To accommodate a diverse user group, the system incorporates a range of man/machine interface features including both menu selection and command language capabilities. Pilot software has been developed to provide early utility at BETC and to carry out the iterative design and implementation sequence needed to capture the dynamic needs of the EOR/ROS information environment.

10241 **(DOE/MC/5532—7) Determination of the effects of sulfur dioxide on recovery systems for CO_2. Final report, 1977-1980.** Sears, J.T. (West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering; Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). Jan 1981. Contract AS05-77ET12025. 70p. NTIS, PC A04/MF A01.

The present study was initiated to investigate the problems associated with recovery of CO_2 from flue gases for enhanced oil recovery. In particular, the scope of this work may be stated: determine the type of impurities formed in ammonia, monoethanolamine (MEA), and potassium carbonate systems when extracting CO_2 from oxidizing flue gases containing nitrogen oxides and sulfur oxides; determine the levels of impurity build-up in the solvents; estimate the impurity level in the recovered CO_2; evaluate the effect on corrosion in metals by these solvents in a flue gas environment; determine the carbon-dioxide absorption coefficients in solvents contaminated due to the pollutants present in the flue gas; evaluate the effect of particulate matter on absorption coefficients in the solvents; and recommend potential absorption systems for CO_2 from flue gas and estimate the cost of recovery. The results of this study indicate that in ammonia, ammonia sulfate is quickly formed to render that portion of the absorbent inactive. In MEA, amine sulfite and amine sulfate are the dominant impurities formed. In amine-activated potassium carbonate solutions, only sulfite and sulfate ions were found. No nitrogen-oxide species were found in any solution. The impurity levels obtained in the present experiments indicated no limit on contaminant build-up. The impurity level in the recovered CO_2 was estimated to be $\leqq$ 100 ppM non-condensible gases, 20 to 200 ppM SO_2, and $<$ 20 ppM NO/sub x. Corrosion in the absorption systems will be similar to that observed in CO_2 absorption systems from reducing gas streams. The absorption rate of CO_2 in solutions decreases with increasing loading of CO_2 in almost a linear fashion. Several alternative absorption systems were evaluated in a preliminary cost evaluation, and a K_2CO_3 (EAE activated) solution was recommended.

10242 **(DOE/MC/03259—10) Enhanced oil recovery by CO_2 foam flooding. Second annual report.** (New Mexico State Univ., Las Cruces (USA). Dept. of Chemical Engineering; Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Nov 1980. Contract AC21-78MC03259. 86p. NTIS, PC A05/MF A01.

The objective is to identify commercially available additives which are effective in reducing the mobility of carbon dioxide, CO_2, thereby improving its efficiency in the recovery of tertiary oil, and which are low enough in cost to be economically attractive. During 1980 significant progress has been accomplished on each major contract objective. The apparatus, design and construction phase of this project is essentially complete. Correlation work on dynamic foam stability, in two-phase flow experiments in a linear sandpack, has shown that the most active foaming agents, as identified in static tests, may not necessarily be the best choices for mobility control in the field. The Alipal CD128-Monamid 150AD system, the leading foam generator in the static test, is slightly inferior to an ethoxylated alcohol, Neodol 23-6.5, that produces only a modest amount of foam in the static test. In the dynamic test, Neodol 23-6.5 lowered gas mobility by about a factor of 2 greater than the Alipal system. Both systems are outstanding in their performance, and further comparative tests are scheduled. A third structure which looks promising based on the interpretation of the above test is a Pluronic surfactant whose hydrophobe consists of polypropylene oxide rather than a linear alcohol as used in the Neodol surfactants. Additional tests on the hydrolysis rate of Alipal-type surfactants indicate that molecular breakdown may not be as rapid as at first suspected. Under neutral conditions the half-life of ethoxylated alcohol sulfates appears to be two to three years at a reservoir temperature of 120°F. The Neodol and Pluronic structures should be even more stable.

10243 **(PB—80-812118) Petroleum exploration, production, and recovery methods. 1964-May, 1980 (citations from the NTIS data base). Report for 1964-May 80.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 286p. NTIS PC N01/MF N01.

Various methods of oil recovery such as water flooding, gas flooding, steam flooding, and thermal recovery methods are discussed in this bibliography of Federally-funded research. Also included are methods used in prospecting for oil and predicting oil recovery; production processes and costs; and mining and petroleum laws of various countries. Offshore drilling and recovery is not included. (This updated bibliography contains 254 abstracts, 58 of which are new entries to the previous edition.)

10244 **(PB—80-812134) Petroleum recovery: reservoir engineering and recovery methods. April, 1979-May, 1980 (citations from the Engineering Index data base). Report for Apr 80-May 80.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 225p. NTIS PC N01/MF N01.

Thermal recovery methods and well stimulation using waterflooding, steam injection, gas injection, and fluid injection techniques are discussed in this bibliography covering worldwide research. Topic areas cover fire flooding. caustic water flooding, miscible displacement, microemulsion flooding, polymer flooding, carbon dioxide miscible flooding, control of water mobility using polymers, and heat loss calculations. Reservoir modeling and simulation studies and studies pertaining to well logging, core analysis, and well perforation are included. A few abstracts discuss techniques of determining residual oil saturation, predicting oil recoverability, and monitoring the degree of flooding. (This updated bibliography contains 214 abstracts, all of which are new entries to the previous edition.)

10245 (SAND—80-1651, pp 181-191) **Enhanced oil recovery through steam drive and permeability enhancement.** Fox, R.L. (Sandia National Labs., Albuquerque, NM). Dec 1980.

From Tar sands permeability enhancement workshop; Albuquerque, NM, USA (8 May 1980).

A pilot project incorporating steam drive with permeability enhancement is described, and the effects of a downhole steam generator process on oil production in other field tests are discussed. The Sandia National Laboratories downhole steam generator program is briefly outlined.

10246 **Enhanced recovery of petroleum.** Buinicky, E.P.; Estes, J.H. (to Texaco Inc). US Patent 4,222,439. 16 Sep 1980. Filed date 7 Aug 1978. vp.

An enhanced oil recovery method comprising injecting an aqueous ammonium bisulfite (NH_4HSO_3) solution into a petroleum-bearing earth formation, heating said injected aqueous solution to a temperature in the range of about 120*-300* F., or higher in the presence of said petroleum-bearing earth formation, flowing said aqueous solution through said petroleum bearing earth formation to drive petroleum to a recovery well, and producing increased amounts of petroleum from said earth formation through said recovery well.

10247 **Methods of small volume pumping especially suited for oil recovery from stripper wells.** Parker, W.H. (to Del Norte Technology Inc). US Patent 4,222,440. 16 Sep 1980. Filed date 27 Nov 1978. vp.

A pair of inverted, concentrically mounted cups are lowered into a pool of liquid at the bottom of a well. The outer cup is a housing connected to atmospheric pressure via a capillary tube extending upwardly to the top of the well. The inner cup is a closed dome. Liquid passes through a check valve in the bottom of the housing and rises in the outer cup, since the capillary tube is open to the atmosphere and bleeds off the air inside the outer cup. Since

the inner cup is closed, air is entrapped therein to limit the rise of liquid in it. When the capillary tube and, therefore, the two cups are pressurized, the check valve closes to prevent escape of liquid from the housing. The liquid rises in the dome to compress the air entrapped therein. When the capillary tube is suddenly opened again to atmospheric pressure, the compressed air entrapped in the closed dome of the inner cup drives the liquid violently up the capillary tube. Inertia carries a substantial amount of this liquid out the free end of the capillary tube and into a catch basin.

10248 Oil recovery process involving the injection of thickened water. Byham, D.E.; Chen, C.S.; Sheppard, E.W. (to Mobil Corp). US Patent 4,222,881. 16 Sep 1980. Filed date 1 May 1978. vp.

Waterflood oil recovery process involving the use of an amphoteric polyelectrolyte as a thickening agent for mobility control. The amphoteric polyelectrolyte is a copolymer of a quaternary vinyl pyridinium sulfonate and a water-insoluble alpha olefin or hydrogenated diene. Specifically disclosed are vinyl pyridinium sulfonate-styrene block copolymers. The amphoteric polyelectrolytes are stable in high temperature and high brine environments.

10249 Tubular interior wiper. Haggard, W.. US Patent 4,221,264. 9 Sep 1980. Filed date 7 Nov 1977. vp.

A wiper for wiping liquids from the interior walls of various tubulars, such as drill pipe, tubing, casing or internal upset pipe is disclosed which is particularly useful in drilling and workover as the tubular member is withdrawn from a well bore. Features of the wiper include the ability to readily and easily pass through and wipe liquids from restricted passages or bores such as internal upset pipe, means for centralizing the wiper in the passages or bore for efficient wiping, pressure equalization for equalizing pressures within the wiper with outside pressures encountered within the well bore, and ease of manufacture, assembly and disassembly, so that the wiper can be manufactured easily, readily and inexpensively, and repairs and replacement of wear prone parts can be readily and inexpensively made. Other features and advantages are disclosed.

10250 Sliding valve pump. Rupert, C.L. US Patent 4,221,551. 9 Sep 1980. Filed date 26 Jun 1978. vp.

A sliding valve pump for oil wells which includes a working barrel having a plurality of apertures located in spaced relationship in the wall thereof and a pair of travelling valves fitted within the working barrel and carried by a plunger rod, the valves also having a plurality of apertures or ports for periodic registration with the ports in the working barrel wall to facilitate pumping of fluid from an oil reservoir or pool to the surface. The pump is designed to pull the oil-gas mixture from the reservoir pool into the lower section of the working barrel on the downward stroke, and to subsequently pump the collected oil through the barrel and tubing upwardly toward the surface on the upward stroke.

10251 Oil recovery method utilizing a dialkyl phenol polyethoxy alkyl sulfonate as a solubilizing co-surfactant. Dunn, N.G.; Hughes, J.W.; Kudchadker, M.V. (to Texaco Inc). US Patent 4,220,204. 2 Sep 1980. Filed date 18 Apr 1979. vp.

The dialkylbenzene polyethoxy alkyl sulfonate is combined with a water soluble petroleum sulfonate surfactant to form an effective surfactant solution that is stable in high salinity environments. The surfactant solution is injected into an underground petroleum reservoir in order to recover crude oil therefrom.

10252 Method of producing self-propping fluid-conductive fractures in rock. Coursen, D.L.; Cowan, G.R. (to Du Pont De Nemours, E I & Co). US Patent 4,220,205. 2 Sep 1980. Filed date 28 Nov 1978. vp.

A fracture that conducts fluid within the confines of an underground rock formation without the need for particulate proppant materials to hold opposing fracture faces apart is created by a method in which a long portion of a hole drilled into the formation has its axis slanted with respect to the directions of the principal stresses, and is pressurized rapidly over its entire length with fluid, preferably by detonating an explosive therein. A hypothetical fracture plane is defined as that plane containing the axis of the hole which is under the least compressive normal stress. When the orientation of the hole axis is such that there is a substantial shear stress on the hypothetical fracture plane, but the normal stress thereon does not greatly exceed the minimum principal stress, the fracture created lies close to the hypothetical fracture plane, and is conductive to fluids. The fracture is conductive because it is held open by the misfit between the opposing faces which arises from the shear displacement of the faces that occurs when the existing shear stress is released by the formation of the fracture.

10253 Quick opening closure arrangement for well completions. US Patent 4,220,206. 2 Sep 1980. Filed date 22 Jan 1979. vp.

A quick opening closure arrangement for controlling flow from a well formation into a tubular member which may be opened by dropping a rod or the like into the tubular member adjacent the earth's surface wherein closure means are provided for closing off the tubular member from the well formation as the tubular member is positioned in the well. Sleeve means support the closure means to close off flow into the tubular member from the well formation and releasable means releasably secure the sleeve means within the tubular member which releasable means is constructed and arranged to enable the sleeve means to shift longitudinally within the tubular member when a rod dropped into the tubular member from the earth's surface impacts thereagainst whereupon the closure means moves to open the tubular member for receiving flow from the formation.

10254 Apparatus for monitoring the operation of well bore guns. Lands, J.F. (to Schlumberger Technology Corp). US Patent 4,220,212. 2 Sep 1980. Filed date 18 Sep 1978. vp.

In the representative embodiment of the new and improved apparatus disclosed herein for monitoring the operation of perforating guns or core-sampling guns carrying one or more electrically-detonatable charges, an impact-actuated monitoring assembly operatively arranged on the body of the gun includes a motion-responsive switch and solenoid device that are connected to the electrical firing circuit of the gun. As the explosive charges connected to the gun-firing circuit are actuated, the new and improved monitoring assembly of the present invention is effective for cyclically varying the impedance of the firing circuit to provide a series of distinctive surface indications showing that the gun has been successfully fired.

10255 Subsea wellhead protective enclosure. Thorne, P.M. (to FMC Corp). US Patent 4,220,421. 2 Sep 1980. Filed date 27 Nov 1978. vp.

Method and apparatus for protecting subsea wellheads and christmas trees from damage by anchors, fishing nets, trawl boards, and other towed devices. The apparatus includes an annular, rigid protective enclosure with inner and outer walls that define a hollow annular chamber, and a plurality of bag-like containers spaced around and attached to the enclosure's outer wall. The annular chamber is in communication with the interiors of the containers by means of ports through the enclosure's outer wall, whereby when cement is pumped into the chamber it also flows into and fills the containers to form a smoothly contoured shield around the enclosure. Should an anchor or other device become fouled on this shield, the container or containers involved will break away and let the anchor continue on its way up and over the enclosure without damage to the wellhead or other well equipment.

10256 Automatic load seeking control for a pumpjack motor. Taylor, N.R.; Taylor, P.A. (to Superior Electric Supply Co). US Patent 4,220,440. 2 Sep 1980. Filed date 6 Apr 1979. vp.

Method and apparatus for matching the power output of a high slip motor to the demand requirement of a pumpjack unit. The stators of the high slip motor are automatically connected in various different configurations to provide the optimum torque as required by the pumpjack unit due to the downhole pumping conditions. A novel control circuitry is connected between the motor starter and the motor stators. The control measures the power drawn by the stators and selects the most optimum configuration thereof for the load required by the pumpjack. This selection operates the motor in the lowest possible torque mode, which is consid-

ered the best electrical and mechanical operation of the pumpjack apparatus.

10257 **Drilling fluid additives.** Green, B.Q.; Javora, P.H. (to Dresser Industries Inc). US Patent 4,220,585. 2 Sep 1980. Filed date 4 Apr 1979. vp.

A drilling fluid additive effective as a viscosity controlling agent is composed of complex titanium or zirconium lignosulfonates and/or salts of lignosulfonic acid. Alternatively , the additive may be a titanium-iron lignosulfonate and/or salt or lignosulfonic acid or a zirconium-iron lignosulfonate and/or salt of lignosulfonic acid. The additive is effective with the lignin component of the lignosulfonate being in either oxidized or unoxidized form.

0204 Processing

REFER ALSO TO CITATION(S) 10173, 11191, 11192

10258 **Catalytic reforming of naphtha fractions.** Bishop, K.C.; Vorhis, F.H. (to Chevron Research Co). US Patent 4,222,854. 16 Sep 1980. Filed date 23 May 1979. vp.

Production of motor gasoline and a btx-enriched reformate by fractionating a naphtha feedstock into a mid-boiling btxprecursor fraction, a relatively high-boiling fraction and a relatively low-boiling fraction; catalytically reforming the btxprecursor fraction in a first reforming zone; combining the relatively high-boiling and low-boiling fractions and catalytically reforming the combined fractions in a second reforming zone.

10259 **Method for promoting regeneration of a catalyst in a fluidized regenerator.** Hansel, J.H.; Linton, R.G.; Stanger, C.W. (to Air Products And Chemicals Inc). US Patent 4,222,856. 16 Sep 1980. Filed date 9 Jun 1977. vp.

A promoter comprising from about 500 ppm to about 1% of a Group V, Group VI, or Group VIII metal on a support is combined with a hydrocarbon conversion catalyst under fluidizing conditions, in an effective proportion, to enhance the removal of carbonaceous material from the catalyst. Typically, the promoter is a mixture of platinum and palladium supported on gamma alumina and is included in a fluidized catalytic cracking (Fcc) unit in a sufficient proportion to provide from about 0.05 to about 50 ppm metal based on the weight of the catalyst.

10260 **Magnesia-alumina-aluminum phosphate-zeolite catalyst.** Reynolds, E.H.; Stanulonis, J.J.; Swift, H.E. (to Gulf Research & Development Co). US Patent 4,222,896. 16 Sep 1980. Filed date 16 Jul 1979. vp.

A catalyst for cracking gasoline feedstock with superior selectivity to gasoline production and greater metals tolerance comprises a magnesia-alumina-aluminum phosphate matrix composited with a zeolite having cracking activity.

10261 **Catalytic cracking with reduced emission of noxious gases.** Ford, W.D.; Hsieh, C.R.; Vasalos, I.A. (to Standard Oil Co (Indiana)). US Patent 4,221,677. 9 Sep 1980. Filed date 19 Mar 1979. vp.

A cyclic, fluidized catalytic cracking process providing reduced emissions of noxious effluents in regeneration zone flue gases is operated with homogeneous or non-homogeneous, regenerable, fluidized, solid particles which are circulated throughout the catalytic cracking process cycle and which comprise (1) a molecular sieve-type cracking catalyst, comprising a cracking catalyst matrix containing crystalline aluminosilicate distributed throughout said matrix and (2) a metallic reactant which reacts with a sulfur oxide to form a metal- and sulfurcontaining compound in the solid particles. The method involves regeneration of the cracking catalyst in the presence of a metallic oxidation promoter which can also be a component of the solid particles.

10262 **Method for preventing coking in fluidized bed reactor for cracking heavy hydrocarbon oil.** Kiuchi, N.; Miyamoto, T.; Satomi, Y.; Tomuro, J.; Uchida, S.; Yamagata, T.; Yoshioka, S. (to Hitachi Ltd (Japan); Nippon Mining Co Ltd (Japan)). US Patent 4,220,518. 2 Sep 1980. Filed date 27 Sep 1978. vp.

In a reactor for cracking heavy hydrocarbon oil through a fluidized bed of particles of natural ores, coke-like materials are deposited on a top of the reactor or pipe inside surfaces of a transfer line from the reactor to a scrubber. To effectively scour out the deposited coke-like materials, particles of natural ores having a mean diameter of a few hundred mu M is made to be contained in an effluent gas from the top of reactor, passing through the transfer line at a concentration of 1 to 40 g/m3. The particles of natural ores have a good effect of scouring out the deposited coke-like materials and can keep the transfer line efficiently clean even with a small amount of the particles of natural ores, decreasing a pressure drop in the transfer line.

10263 **Method of suppressing the rise in surface temperature of heating tubes by ammonia injection.** Fujita, K.; Owan, Y.; Ozawa, M. (to Nippon Petroleum Refining Co Ltd (Japan)). US Patent 4,220,519. 2 Sep 1980. Filed date 9 Nov 1978. vp.

According to this invention, there is provided a method of suppressing the rise in surface temperature of the heating tubes in a fractionation apparatus for a crude oil, characterized in that an aqueous solution containing ammonia or ammonium ion is injected into the upstream line of the crude heater in an amount of 1 to 20 ppm in terms of ammonia based on the crude oil.

10264 **Startup method for a reforming process.** Carter, J.L.; Sinfelt, J.H. (to Exxon Research And Engineering Co). US Patent 4,220,520. 2 Sep 1980. Filed date 16 Nov 1978. vp.

A startup method for a catalytic reforming process wherein the catalyst is maintained in a bed is provided in which a catalyst comprising an iridium component and at least one additional metal component such as a platinum group metal component is reduced, sulfided and contacted with hydrogen at specified conditions whereby the sulfur is distributed uniformly throughout the catalyst bed prior to contacting the catalyst with the hydrocarbon feed.

10265 **Fluidized catalytic cracking reactor.** Brown, J.D.; Jahnke, F.C.; Maclean, J.P.; Williams, D. (to Texaco Inc). US Patent 4,220,623. 2 Sep 1980. Filed date 29 Mar 1978. vp.

A fluidized catalytic cracking unit wherein cyclone diplegs extend from the reactor vessel into the stripping vessel, for reducing the overall height of the unit. Valve means are provided at the lower end of the diplegs to prevent blow by of gas through the diplegs. The diplegs pass through the vent lines.

10266 **Hydrocarbon dehydrocyclization with a superactive multimetallic catalytic composite.** Antos, G.J. (to Uop Inc). US Patent 4,220,521. 2 Sep 1980. Filed date 26 Apr 1979. vp.

Dehydrocyclizable hydrocarbons are converted to aromatics by contacting them at hydrocarbon dehydrocyclization conditions with a superactive acidic multimetallic catalytic composite comprising a combination of a catalytically effective amount of a pyrolyzed rhenium carbonyl component with a porous carrier material containing a catalytically effective amount of a halogen component and a uniform dispersion of a catalytically effective amount of a platinum group component which is maintained in the elemental metallic state. The platinum group, pyrolyzed rhenium carbonyl and halogen components are present in the multimetallic catalyst in amounts respectively, calculated on an elemental basis, corresponding to about 0.01 to about 2 wt. % platinum group metal, about 0.01 to about 5 wt. % rhenium, and about 0.1 to about 3.5 wt. % halogen. A specific example of a dehydrocyclization method disclosed herein is a method for converting a feed mixture of n-hexane and n-heptane to a product mixture of benzene and toluene which involves contacting the feed mixture and a hydrogen stream with the superactive acidic multimetallic catalyst disclosed herein at hydrocarbon dehydrocyclization conditions.

0205 Products And By-products

10267 Diesel fuel containing wax oxidates to reduce particulate emissions. Sprague, H.G.; Sweeney, W.M. (to Texaco Inc). US Patent 4,222,746. 16 Sep 1980. Filed date 25 Apr 1979. vp.

Addition of 0.1 to 1.5 percent by weight of wax oxidates to a diesel fuel is found to reduce the amount of soot and invisible particles produced when the fuel is used in a diesel engine. The wax oxidates act synergistically with fuel-soluble organometallic compounds such as alkyl cyclopentadienyl manganese tricarbonyl complex salts in reducing particulates. The wax oxidates used have a ratio of neutralization number to saponification number below about 0.40 and a saybolt universal viscosity at 210° F. Higher than 1600.

10268 Polymers bearing groups derived from n-substituted lactams and their use as lubricating oil additives. Brulet, D.; Chauvel, B.; Pocheville, R. (to Institut Francais Du Petrole (France); Rhone-Poulenc Industries (France)). US Patent 4,222,882. 16 Sep 1980. Filed date 26 Jan 1979. vp.

Novel lubricating oil polymer additives are obtained by the following: (1) by preparing, by anionic polymerization, a living diene polymer of mn of between about 20,000 and 300,000; (2) by functionalizing the said polymer by means of an nsubstituted lactam of the type of n-alkylcaprolactam, nbinylcaprolactam, and particularly of the type of nalkylpyrrolidione and n-vinylpyrrolidone; and (3) by hydrogenating the said functionalized polymer. A variant method of preparing the said polymers comprises subjecting the living polymer to a metalation operation before functionalization; the hydrogenation operation is carried out before metalation or after functionalization. The said polymers may be used as additives which improve the viscosity index and the dispersing power of lubricating oils. The amount of additive added is between about 0.1 and 10 percent by weight.

10269 4,4'-furfurylidene bis(2,6-di-tert-butylphenol)antioxidant. Clinton, E. (to Ethyl Corp). US Patent 4,222,883. 16 Sep 1980. Filed date 2 Oct 1978. vp.

Organic material is effectively stabilized against oxidative degradation by adding a small amount of 4,4'-furfurylidene bis(2, 6-di-tert-butylphenol).

10270 Antioxidant. Malec, R.E. (to Ethyl Corp). US Patent 4,222,884. 16 Sep 1980. Filed date 4 Dec 1978. vp.

Organic material is stabilized against oxidative degradation by the addition of a small amount of an antioxidant compound or mixture of compounds containing a central segment of one to about ten divalent o-hydrocarbyl phenol groups (e.g., O-tertbutylphenol) bonded to each other through a methylene group and having terminal 3,5-dihydrocarbyl-4-hydroxybenzyl groups at each end. They are made by first condensing o-hydrocarbyl phenol with formaldehyde and then reacting the intermediate with 2,6dihydrocarbyl phenol and formaldehyde.

10271 Metal phenates. Robson, R.; Swinney, B.; Tack, R.D. (to Exxon Research And Engineering Co). US Patent 4,221,673. 9 Sep 1980. Filed date 20 Jan 1978. vp.

Metal phenates especially overbased phenates are prepared by reacting a basic metallic compound with a mixture of an alkyl phenol and an alkyldihydroxybenzene. The products are useful as lubricant additives with improved antirust properties, and when overbased, with higher basicity and lower viscosity.

0206 Health And Safety

10272 (AD-A—086061) Detonation-flame arrester devices for gasoline cargo vapor recovery systems. Final report. Bjorklund, R.A.; Ryason, P.R. (Jet Propulsion Lab., Pasadena, CA (USA)). Mar 1980. 227p. NTIS, MF A01.

An experimental program was carried out to (1) develop empirical data on the deflagration-to-detonation run-up distance for flowing mixtures of gasoline and air in 15.2-centimeters- (6.0-inches-) diameter piping simulating a vapor recovery system, and (2) evaluate the quenching capability of eight selected flame control devices subjected to repeated stable detonations. The deflagration-to-detonation run-up distance was found to be 11.2 m (36.7 ft), or a length-to-diameter ratio of 74. The relative roughness of the run-up length of piping was 0,010 to 0.015. The stable detonation downstream of the transition point has a velocity of 1800 m/s (5906 ft/s) with a stable peak pressure of 1900 kn/m2 to the 2nd power (275 psia). There appeared to be no discernable correlation between the initial flow velocity used in testing and the resulting run-up distance. Detonations were obtained only at equivalence ratios greater than 0.8; however, there was no correlation between equivalence ratio and run-up distance for equivalence ratios ranging from 0.9 to 1.4. The successful detonation-flame arresters were: (1) sprial-wound, crimped aluminum ribbon, (2) foamed nickel-chrome metal, (3) vertically packed bed of aluminum Ballast rings, and (4) water-trap or hydraulic back-pressure valve.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 11042

10273 (EMD—80-72) Oil and natural gas from Alaska, Canada, and Mexico: only limited help for US. Staats, E.B. (General Accounting Office, Washington, DC (USA)). 11 Sep 1980. 94p. GPO.

Report to the Congress of the United States by the Comptroller General.

The gap between US oil and natural gas consumption and production is expected to continue, even widen during the 1980s. Although Alaska's resources appear promising, minimum time for development will limit its contribution. Canadian oil exports are being phased out, and its optimistic gas potential is not expected to result in large exports in this century. Mexico will probably become a primary source of US oil imports over the next decade. Even so, anticipated oil and gas from Alaska, Canada, and Mexico will not be sufficient to offset anticipated domestic production declines. Synfuels probably will not alleviate the decline in US production development during the 1980s. Unconventional gas production, however, appears to offer higher potential for development in this time frame.

0208 Waste Management

10274 Apparatus for removing hydrocarbons from drill cuttings. Barthel, H.K. (to Oil Base Germany G.m.b.H., Hamburg). US Patent 4,222,988. 16 Sep 1980. Filed date 5 May 1978. vp.

Method and apparatus for removing hydrocarbons from drill cuttings is disclosed. The method involves heating the contaminated drill cuttings at a pressure lower than atmospheric pressure, milling the cuttings to expose hydrocarbons trapped within agglomerates of the material, and separating the vapors thereby produced from the cuttings. The cleaned cuttings can be used or disposed of without damage to the environment. The vaporized hydrocarbons may be condensed and recovered.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 10177, 10239, 10391, 11555, 11592

10275 (CONF-800334—(Vol.2), pp 561-588) Combustion: an oil spill mitigation tool. Thompson, C.H.; Dawson, G.W.; Goodier, J.L. (Battelle Pacific Northwest Labs., Richland, WA). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

DOE and the United States Coast Guard (USCG) have established programs to assess the problems of oil spills and are actively developing information and understanding as they implement contemporary solutions. This paper reports on the results of a study which explores the technical feasibility of using combustion technology in oil spills: (a) in situ - where the stricken tanker poses an unreasonable risk and the burning of cargo would minimize pollution; (b) pool - where the oil has been released from containment and is spreading upon water or ice; and (c) debris - where the re-

leased oil has come in contact with beaches, littoral deposits, flotsam, jetsam, and other materials requiring disposal. The research was conducted through literature, international correspondence, and interviews to determine: (a) categories of oils by their propensity to burn; (b) conditions affecting burning; (c) available technology to be used; (d) acceptability and ethics of using this technology; and (e) research and technology development needed. Practical guidance is offered through the use of decision trees.

10276 **(DOE/RA—7137) Strategic Petroleum Reserve, West Hackberry oil storage cavern fire and spill of September 21, 1978: an environmental assessment. Final report.** Taylor, A. (Dames and Moore, Houston, TX (USA)). 29 Feb 1980. Contract AC96-78P007137. 680p. NTIS, PC A99/MF A01.

This report summarizes an environmental assessment of the fire and oil spill at the Strategic Petroleum Reserve site, West Hackberry, Louisiana. Subjective identification of oil contaminated habitats was supported by a more rigorous classification of samples utilizing discriminant analysis. Fourteen contaminated stations were identified along the shore of Black Lake just north and west of Wellpad 6, encompassing approximately 9 hectares. Seasonal variation in the structures of marsh and lake bottom communities in this contaminated area were not generally distinguishable from that of similar communities in uncontaminated habitats along the southern and southeastern shores of Black Lake. The major impact of spilled oil on the marsh vegetation was to accelerate the natural marsh deterioration which will eventually impact animals dependent on marsh vegetation for habitat structure. Vanadium, the predominate trace metal in the oil, and pyrogenic products due to the fire were found at the most distant sampling site (5 km) from Cavern 6 during Phase I, but were not detected downwind of the fire in excess of background levels in the later phases. Remote sensing evaluation of vegetation under the plume also indicated that stress existed immediately after the fire, but had disappeared by the end of the 1-year survey.

10277 **(PB—80-182769) Pollutants from synthetic fuels production: coal gasification screening test results. Research report.** Cleland, J.G.; Gangwal, S.K.; Sparacino, C.M.; Zweidinger, R.M.; Nichols, D.G. (Research Triangle Inst., Research Triangle Park, NC (USA)). Aug 1979. 104p. NTIS, PC A06/MF A01.

Coal gasification test runs have been conducted in a semi-batch, fixed-bed laboratory gasifier in order to evaluate various coals and operating conditions for pollutant generation. Thirty-eight tests have been completed using char, coal, lignite, and peat. Extensive analyses were performed for organic and inorganic compounds and trace elements in the tars and hydrocarbon oils, aqueous condensates, and reactor residues resulting from the gasification tests. Over 300 compounds were identified from the various gasifier streams, and more than 100 of these compounds were quantified for several of the test runs. Statistical analyses have been performed on the data. The quantity and composition of the various effluents have been examined in relation to coal type and operating variables. Results are reported for sulfur species in the product gas stream, for consent decree pollutants contained as volatile organic compounds in the product gas, for phenol and related compounds in the aqueous condensate and tar/oil sample, and for polynuclear aromatic hydrocarbons (PNA) species in the tar/oil.

10278 **(PB—80-183098) Environmental assessment: source test and evaluation report - Lurgi (Kosovo) medium-Btu gasification, Phase 1. Report for Sep 78-Jun 79.** Bombaugh, K.J.; Corbett, W.E.; Matson, M.D. (Radian Corp., Austin, TX (USA)). Aug 1979. 145p. NTIS, PC A07/MF A01.

The report summarizes an ongoing test program involving a commercial medium-Btu Lurgi coal gasification plant in the Kosovo region of Yugoslavia. The environmental data acquisition program is sponsored by the U.S. EPA and the government of Yugoslavia. The objective of the program is to characterize potential environmental problems and control technology needs associated with the gasification of lignite coal in a state-of-the-art Lurgi gasification plant. This timely program is enabling the EPA to study firsthand the environmental problems which may be encountered by future operators of U.S. gasification plants. Phase I of the tests, now complete, concentrated on the characterization of major pollutants in the plant's gaseous emissions. Some characterization of the plant's liquid and solid waste streams and its by-products were also performed. A SAM/IA analysis of the gaseous emissions indicated that the major pollutants of concern are CO, benzene, H2S, mercaptans, and NH3. The Phenosolvan effluent contained a high concentration of organics and had a high (11-12) pH. The sulfur concentration of lights (i.e., gasoline) in the by-product streams was significantly higher than that of the heavies (i.e., tar). Phase II will emphasize detailed characterization of trace organics and trace elements in the plant's multimedia waste streams and control options.

10279 **(PB—80-187305) The fate and effects of crude oil spilled on subarctic permafrost terrain in interior Alaska. Final report 1975-1979.** Johnson, L.A.; Sparrow, E.B.; Jenkins, T.F.; Collins, C.M.; Davenport, C.V. (Army Cold Regions Research and Engineering Lab., Fort Wainwright, AK (USA). Alaskan Projects Office). Mar 1980. 143p. NTIS, PC A07/MF A01.

This study was conducted to determine both the short- and long-term effects of spills of hot Prudhoe Bay crude oil on permafrost terrain in subarctic interior Alaska. Two experimental oil spills of 7570 liters (2000 gallons) each on 500sqm test plots were made at a forest site underlain by permafrost near Fairbanks, Alaska. The oil spills, one in winter and one in summer, were conducted to evaluate their effect during these two seasonal extremes. Oil movement, thermal regime, botanical effects, microbiological responses, permafrost impact, and composition of the oil in the soil were monitored for two years.

10280 **(PB—80-187594) Determination of air pollutant emission factors for thermal tertiary oil recovery operations in California. Volume I. Final report.** Taback, H.J. (KVB, Inc., Irvine, CA (USA). Research and Analysis Div.). May 1980. 92p. NTIS, PC A05/MF A01.

This report presents the results of a study to determine the nature and extent of air pollutants resulting from thermally enhanced oil recovery operations in California and to determine emission factors for some of the sources of these pollutants. The pollutants of concern were particulate matter, sulfur oxides, nitrogen oxides, carbon monoxide, hydrocarbons, and hydrogen sulfide. Emission factors were developed by source testing steam generators and two types of well vents--those associated with steam injection fields and those associated with in-situ combustion (or fireflood) oil recovery methods.

10281 **(PB—80-187602) Determination of air pollutant emission factors for thermal tertiary oil recovery operations in California. Volume II - Appendix. Final report.** Taback, H.J. (KVB, Inc., Irvine, CA (USA). Research and Analysis Div.). Nov 1979. 190p. NTIS, PC A09/MF A01.

Volume II of the report is an appendix that contains detailed data from tests conducted during the program.

10282 **Ultrasonic oil spill removal.** Kuris, A. US Patent 4,222,868. 16 Sep 1980. Filed date 8 Nov 1978. vp.

Oil slicks on surface waters are dispersed by the exposure of the surface oils to ultrasonic energy to effectuate an homogenization of the oil and water to permit absorbtion of the oil within the total volume of water.

10283 **Alien liquid detector and control .** Potter, B.M. US Patent 4,220,041. 2 Sep 1980. Filed date 4 Dec 1978. vp.

An alien liquid detector employs a monitoring element and an energizing circuit for maintaining the temperature of the monitoring element substantially above ambient temperature. For this purpose an electronic circit controls a flow of heating current to the monitoring element. The presence of an alien liquid is detected by sensing a predetermined change in heating current flow to the monitoring element, e.g., to distinguish between water and oil. In preferred embodiments the monitoring element is a thermistor whose resistance is compared with a reference resistance and heating current through the thermistor is controlled in accordance with the difference. In one embodiment a bridge circuit senses the resistance difference; the difference may be sensed by an operational am-

plifier arrangement. Features of the invention include positioning the monitoring element at the surface of water, slightly immersed, so that the power required to maintain the thermistor temperature substantially above ambient temperature serves to detect presence of oil pollution at the surface.

10284 **Environmental aspects of oil and gas production.** Kereluk, M.J. pp Paper 38, 499-533 of Energy: the new rules. Newman, D.T. (ed.). Santa Monica, CA; Management Education Corporation (1979).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

The major environmental laws, regulations, and programs affecting the oil industry are listed. Drilling and production activities are described. The environmental aspects of oil and gas production activities to the air, water, and land are discussed. Pollutants are quantified and control technologies are described. Specific areas under regulation are identified. (DMC)

0210 Legislation And Regulation

10285 (CONF-800334—(Vol.1), pp 495-502) **Coping with environmental problems of heavy oil production.** Peterson, G.D. (Dept. of Energy, San Francisco, CA). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The production of heavy oil is receiving increased attention as a means of reducing our dependence on foreign oil imports. Most United States production of heavy crude occurs in California, where air quality problems are especially difficult. This paper looks at the impact of environmental regulations adopted in Kern County, California, exclusively for the oil industry. California heavy oil production is in a period of rapid growth. Maintenance of air quality has required increased regulation and emission controls for steam generators. This has resulted in delays in the granting of permits for new steam generation capacity, but not in any substantial denial of permits. Emission control technology is available for SO_2 and under development and field testing for NO/sub x/. The degree of NO/sub x/ control to be required on new steam generators and the availability of emission offsets are major concerns. Particulate control could be the next major issue. The California Air Resources Board has taken firm actions to protect air quality but has not adopted overly restrictive regulations.

0220 Transport, Pipelines, And Handling

10286 **(ORNL—5697) Oil pipeline energy consumption and efficiency.** Hooker, J.N. (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-26. 263p. NTIS, PC A12/MF A01.

This report describes an investigation of energy consumption and efficiency of oil pipelines in the US in 1978. It is based on a simulation of the actual movement of oil on a very detailed representation of the pipeline network, and it uses engineering equations to calculate the energy that pipeline pumps must have exerted on the oil to move it in this manner. The efficiencies of pumps and drivers are estimated so as to arrive at the amount of energy consumed at pumping stations. The throughput in each pipeline segment is estimated by distributing each pipeline company's reported oil movements over its segments in proportions predicted by regression equations that show typical throughput and throughput capacity as functions of pipe diameter. The form of the equations is justified by a generalized cost-engineering study of pipelining, and their parameters are estimated using new techniques developed for the purpose. A simplified model of flow scheduling is chosen on the basis of actual energy use data obtained from a few companies. The study yields energy consumption and intensiveness estimates for crude oil trunk lines, crude oil gathering lines and oil products lines, for the nation as well as by state and by pipe diameter. It characterizes the efficiency of typical pipelines of various diameters operating at capacity. Ancillary results include estimates of oil movements by state and by diameter and approximate pipeline capacity utilization nationwide.

10287 **Apparatus for freezing a slug of liquid in a section of a large diameter fluid transmission line.** Brister, B.D. US Patent 4,220,012. 2 Sep 1980. Filed date 16 Feb 1978. vp.

Apparatus is described for freezing a slug of liquid to form an ice plug in a section of a pipeline for hydrostatic testing purposes. The ice plug is formed by transferring thermal energy from the slug of liquid through the walls of the pipeline to a cryogenic cooling fluid such as liquid nitrogen. A section of the pipeline is filled with liquid and is enclosed by an insulated housing which defines a cooling chamber. The chamber is filled with liquid nitrogen to form a pool around the pipeline. The liquid nitrogen is agitated by discharging a stream of liquid nitrogen or nitrogen vapor through the pool. Heat exchange occurs as a result of sensible heat transfer directly from the surface of the pipeline to the pool of liquid nitrogen. In a preferred embodiment, the liquid nitrogen is discharged uniformly over the surface of the pipeline as the chamber is filled by means of an insulated header which forms a part of the chamber housing.

10288 **Offshore loading system with articulated manifolds.** Gill, W.A. (to FMC Corp). US Patent 4,220,177. 2 Sep 1980. vp.

An offshore loading system especially suited for transferring petroleum from a floating storage and loading terminal to a marine tanker. The system comprises a support boom pivotally mounted on the deck of the terminal, a pair of fluid conduits extending generally horizontally along the boom from risers at the deck, a pair of vertical fluid conduits slidably connected to the outboard end of the boom and a pair of articulated manifold assemblies connected between the lower ends of the vertical conduits and the marine tanker. The outboard end of the horizontal conduits are articulated and are connected by swivel joints to the vertical conduits to facilitate raising and lowering the vertical conduits relative to the outboard end of the boom. The articulated manifold assemblies accommodate relative horizontal movement between the tanker and the loading terminal so that the horizontal position of the fluid conduits remains constant and simple and relatively light-weight fluid conduits may be used with the support boom.

0230 Properties

10289 **(AD-A—086740) Gasolines and engine oils: literature review, new laboratory oxidation method, and significance of olefins in fuel. Final report.** Kolobielski, M.; McCaleb, F. (Army Mobility Equipment Research and Development Center, Fort Belvoir, VA (USA)). Mar 1980. 89p. NTIS, PC A05/MF A01.

Review of literature on oxidation of gasolines and lubricating engine oils indicated shortcomings in present laboratory bench oxidation and engine tests. These tests are re-examined and their significance and some causes of poor precision are discussed. The newly developed laboratory oxidation method overcomes the shortcomings of the bench tests. The new method consists of oxidizing a liquid sample in an autoclave under oxygen pressure at desired temperature for a determined period of time. A uniform and constant reaction temperature is maintained by stirring both the sample and the heating oil bath. Gasolines rich in reactive olefins were found prone to oxidation. It is predicted that in the future gasolines may contain high percentage of olefins, gum precursors, because of their high blending octane number. Oxidative stability of formulated engine oil does not correlate with base stock oxidative stability or with the oil performance in engine and field tests. The lack of correlation is explained by the fact that the degradation of crankcase oil is caused by several factors, of which oxidation is only one.

10290 **(PB—80-184203) Physical properties and stability of water in fuel oil emulsions. Final report.** Fogler, H.S.; Reddy, S.R.; Siegmund, S.C.; Palazzolo, M.A. (Michigan Univ., Ann Arbor (USA). Dept. of Chemical Engineering). Jan 1980. 146p. NTIS, PC A07/MF A01.

This report presents the second year from a two year effort to determine the physical properties of water-in-fuel oil emulsions. Ultrasonically induced interfacial instability and cavitation were used to produce emulsions of water-in-gasoline, No. 2 diesel oil, No. 4 heating oil and No. 6 fuel oil without the addition of surfac-

tants. Compressibility measurements are presented for each of the four fuel oils as a function of water volume fraction. Measurements are also presented for No. 4 heating oil as a function of temperature. Corrosion rates for mild steel were measured in emulsions of No. 6 fuel oil at 10% volume fraction of water at 70C and 90C. The viscosity of oil-in-water emulsions was studied as a function of volume fraction of oil and of particle size distribution of oil in the emulsions. The stability of the oil-in-water emulsion was studied for the case of simultaneous creaming and flocculation.

0240 Storage

REFER ALSO TO CITATION(S) 10276

0250 Combustion

REFER ALSO TO CITATION(S) 10212, 10419

03 NATURAL GAS

REFER ALSO TO CITATION(S) 10233

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 10234, 10235, 10346

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 10253, 10255, 10257

0305 Health And Safety

REFER ALSO TO CITATION(S) 10300

10291 (CONF-800334—(Vol.2), pp 547-560) **Extinguishment and control of LPG fires.** Martinsen, W.E.; Johnson, D.W.; Welker, J.R. (Applied Technology Corp., Norman, OK). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The burning rates of LPG fires are primarily a function of the fire size and reach a maximum of about 0.45 in/min for fires larger than about 20 ft in diameter. LPG fires can be controlled (but not extinguished) by application of high expansion foam. The foam rate required for LPG fires is less than for LNG fires at comparable burning rates, and the reduction in fire size is about the same as for LNG fires. For the foam used in these tests, the application rate should be in the range of 0.1 to 0.15 gal/min-ft^2 at an expansion ratio of 500:1 in order to provide control within a few minutes. Radiation fluxes from the fire were reduced by as much as 85 to 90 percent. Experience with LNG fires has shown wide variability in the effectiveness of various types of high expansion foam for controlling LNG fires. The same variability may be expected for LPG fires. Dry chemical agents applied with properly designed fixed systems or manned hoselines are effective in extinguishing LPG fires. Sodium bicarbonate will be less effective at low application rates than potassium bicarbonate or urea-potassium bicarbonate. However, the longer projection range and higher flow rates for a given system design and the lower cost of agent make sodium bicarbonate an attractive choice for large fixed systems discharging at high rates.

0306 Marketing And Economics

10292 **(EMD—80-53) Guidance needed on use of natural gas price escalator clauses.** Staats, E.B. (General Accounting Office, Washington, DC (USA)). 25 Jul 1980. 35p. NTIS.

Report to the Congress of the United States by the Comptroller General.

Congressional intent has been unclear concerning the use of price escalator clauses in existing natural gas contracts to obtain Natural Gas Policy Act of 1978 prices. In December 1978, the Federal Energy Regulatory Commission issued interim regulations disallowing the use of such clauses. Subsequently, the Commission issued several orders, one of which reversed the original decision concerning these clauses. After the reversal, affected parties petitioned the courts to review the legality of these actions. The Commission should establish a system to monitor the results of its price escalator clause decisions. In future situations involving energy issues of national importance, it should seek clarification of congressional intent when appropriate and analyze economic impacts before making decisions. The Congress should consider amending the Natural Gas Policy Act of 1978 to provide guidance on the price escalator clause issue.

10293 **(EMD—80-96) Natural gas incremental pricing: a complex program with uncertain results and impacts.** (General Accounting Office, Washington, DC (USA)). 4 Sep 1980. 57p. GPO.

Report to the Congress of the United States by the Comptroller General.

The Natural Gas Policy Act calls for industrial customers of interstate natural gas pipelines to pay a surcharge on their fuel purchases. The legislation provides an incentive for the industrial users - who want to keep their costs low - to pressure their suppliers to obtain natural gas at the lowest possible cost. The ultimate beneficiaries of the lower prices will be residential and small commercial users. The Federal Energy Regulatory Commission issued regulations for the incremental pricing program as required. However, GAO believes that there may be problems in carrying out the program the Commission has designed. The Commission will lack the basic data it needs to determine whether its regulations will have the intended impact on prices. The Commission also has overlooked the need to assess the administrative costs of the program and to plan procedures for evaluating the benefits and drawbacks of the program.

10294 **(FE—8680-T1) Natural gas rate design. Final report.** (Zinder (H.) and Associates, Washington, DC (USA)). 12 Mar 1979. Contract EM-77-C-01-8680. 372p. NTIS, PC A16/MF A01.

The results of a survey of gas companies in the US on gas utility rate structure are presented. Technical and economic analyses are performed. Also included in this report are the results of surveys of international gas organizations on rates in effect outside of the US. A set of guidelines on rate structure are presented which are applicable to a broad range of decision-making possibilities. Institutional factors are considered. (DMC)

0308 Environmental Effects

REFER ALSO TO CITATION(S) 10284

10295 (CONF-800334—(Vol.1), pp 503-519) **Environmental effects and controls associated with extraction of unconventional gas.** Krickenberger, K.R.; Trudeau, P.N. (The MITRE Corp., McLean, VA). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The Enhanced Gas Recovery Program (EGR), is composed of four projects - the Eastern Gas Shale Project (EGSP), the Methane from Coal (MFC) Project, the Western Gas Sands Project (WGSP) and the Geopressured Aquifers Project (GPA). Broad program goals are to add 10 Tcf of producible reserves to existing recoverable reserves by 1985, increase gas production by a 3 Bcf/day by 1985, and accelerate development of cost-effective technology that can be readily transferred to the private sector. The purpose of this paper is to provide information on the R and D program, the resource base and the technology; present an overview of the environmental problems associated with development of the unconventional gas resource; and delineate the environmental control strategies and technologies which can properly be applied to eliminate or reduce these problems. Environmental Impacts from the Enhanced Gas Recovery Programs will be similar in most respects to those previously experienced in conventional gas drilling operations such as soil erosion, stream sedimentation, air pollution, noise pollution, critical habitat destruction, degradation of high quality

farmland and wetlands, and socioeconomic stresses or communities. A preventative strategy has been outlined to avoid or at least mitigate the severity of these problems. Well stimulation (EGSP, MFC, WGSP), fluid withdrawal (GPA and potentially MFC) andfluid reinjection (GPA and potentially MFC) are processes inherently different from those encountered in conventional gas drilling. The potential impacts are ground water pollution from fracturing fluid, connection of subsurface aquifers of varying qualities, and subsidence of the overlying land surface. Methods to eliminate or ameliorate these impacts have also been outlined. The environmental control strategy for extraction of unconventional gas is one of preventative planning, good housekeeping and successful monitoring programs.

10296 **(UCID—18907) Selecting optimum periods for atmospheric dispersion tests over water surfaces at Frenchman Flat, Nevada Test Site.** Shinn, J.H.; Cederwall, R.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1981. Contract W-7405-ENG-48. 12p. NTIS, PC A02/MF A01.

This report utilizes meteorological data collected at Frenchman Flat, Nevada Test Site, as the basis of a strategy for conducting spill tests of liquefied gaseous fuels (LGF) over shallow water surfaces. Diurnal flow patterns show that the optimum period for atmospheric dispersion testing is between 11 AM and 8 PM in any season, while periods to be avoided are between 8 AM and 11 AM and especially the period between 8 PM and 11 PM. The temperature lapse rate over shallow water is most stable during the afternoons from May through December, most unstable during afternoons from December through March, and nearly neutral in April afternoons. The wind speed increases regularly every afternoon and is persistent from the south, south-west during March through November, which allows one to select for any desired speed and to fix an array of instruments along one direction. Because of the combined effects of lapse rate and wind speed the most-stable-atmosphere cases occur at 2 PM to 4 PM, May through December. The most-unstable-cases occur at 2 PM to 4 PM, January to April, and the neutral-stability-cases occur between 4 PM and 6 PM in any season. Finally, including other factors such as maintaining a water surface with favorable precipitation/evaporation, avoiding freezing, and allowing for a range of stability conditions, in considering all factors together, we recommend that planned atmospheric dispersion tests be selected during afternoon periods from two seasons, March-April-May and October-November.

10297 **(UCRL—53078) One-dimensional numerical fluid dynamics model of the spreading of liquefied gaseous fuel (LGF) on water.** Stein, W.; Ermak, D.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Nov 1980. Contract W-7405-ENG-48. 21p. NTIS, PC A02/MF A01.

A computer model has been developed to simulate the spreading of an evaporating liquefied gaseous fuel that has been spilled on the surface of a denser liquid. This would correspond, for example, to the spreading of liquefied natural gas spilled onto water. The model is based on the one-dimensional, time-dependent equations of conservation of mass and momentum, with the assumption that the pool of liquid fuel spreads in a radially symmetric manner. It includes the effects of vaporization, shear at the fuel-liquid interface, and buoyancy due to the density difference between the fuel and the liquid onto which it is spilled. Both instantaneous and continuous spills of finite volume are treated. The height and spreading velocity of the pool of spilled fuel are calculated as functions of time and radius by numerically solving the conservation equations with a finite difference method. Output of the calculations is presented in both tabular and graphical form.

0309 Artificial Stimulation

10298 (SAND—80-1651, pp 123-146) **Enhanced formation permeability through tailored-pulse loading of wellbores.** Schmidt, R.A.; Warpinski, N.R.; Cooper, P.W. (Sandia National Labs., Albuquerque, NM). Dec 1980.

From Tar sands permeability enhancement workshop; Albuquerque, NM, USA (8 May 1980).

This paper describes a series of five full-scale tests performed to evaluate various multi-frac concepts at NTS in cased, horizontal boreholes: (1) decoupled explosive, (2) a decoupled explosive with propellant booster, (3) a small-diameter propellant charge with pressurized water pad, (4) three successive shots of Case C, and (5) a full-diameter charge of a progressively burning propellant. Results show a large increase in formation permeability for (5), modest increases for (2), (3), and (4), and a decrease for (1) that appears due to the formation of a stress cage. Comparison of (5) results with previous tests suggests a multiple fracture criterion based on pressure rate with little effect of peak pressures.

10299 (SAND—80-1651, pp 147-156) **Massive hydraulic fracture mapping.** Schuster, C.L. (Sandia National Labs., Albuquerque, NM). Dec 1980.

From Tar sands permeability enhancement workshop; Albuquerque, NM, USA (8 May 1980).

Massive hydraulic fracture diagnostic experiments in FY 79 focused on the development of wireline tool instrumentation. The development of the Borehole Seismic System and Borehole Hydrophone System should lead to a more direct method of obtaining fracture orientations and fracture heights than presently exists. These systems can be deployed in the well to be stimulated and can monitor seismic activities before and after nonproppant fluid pumping periods. This seismic activity should occur along the induced fractures, and the location of the seismic sources will be indicative of the fracture locations. The experiments conducted at DOE's Nevada Test Site with known signal locations substantiate field data obtained in two experiments with Amoco in their Wattenberg field where fracture orientation was detected. Recent activities in the Sandia Enhanced Gas Recovery Program are also described.

0320 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 10287

10300 (CONF-800334—(Vol.2), pp 511-530) **Review of the feasibility of methods for reducing LNG tanker fire hazards.** Allan, D.S.; Athens, P.; Phani Raj, P.K.; Pollak, E.G. (Arthur D. Little, Inc., Cambridge, MA). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The extent of the fire hazards has resulted in a focus on the risks of LNG tankers transiting United States ports, particularly in populated or industrialized areas. The identification and evaluation of potential tanker failure modes have resulted in a general consensus that the primary risk is a collision of an LNG tanker with another ship. Since the double hull and double bottom design of LNG tankers renders them significantly resistant to impacts of any kind, a major spill would have to be caused by a rather large impacting ship, traveling at an appreciable speed, and impacting the LNG tanker near beam-on. In spite of the low risk and precautionary measures, the possibility of a major accident occurring remains. Therefore, methods of reducing the consequences of a spill collision are examined as a means of acquiring an additional safety margin for tanker shipments. In this study, engineering concepts on reducing LNG tanker fire hazards are identified and evaluated.

04 OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 11061

0402 Site Geology And Hydrology

10301 **(TR—25) Unconventional petroleum resources in California.** Hallmark, F.O. (California Div. of Oil and Gas, Sacramento (USA)). Sep 1980. 21p. California Div. of Oil and Gas, Sacramento, CA.

The distribution, physical characteristics, and potential of some of the more significant unconventional deposits in California are described in this report: diatomaceous oil shale in southern San Joaquin Valley and Casmalia area-Santa Barbara County; oil and tar sands in Oxnard oil field, Arroyo Grande, Santa Maria Valley, Sisquoc area, Salinas Valley, Richfield tar sand; and minor deposits in Santa Cruz County, Point Arena area-Mendocino County, and McKittrick tar sands. (DLC)

0403 Drilling, Fracturing, And Mining

REFER ALSO TO CITATION(S) 10252, 10313

10302 **(LA—8396-PR) Explosively produced fracture of oil shale. Progress report, April-June 1979.** Morris, W.A. (comp.). (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 36p. NTIS, PC A03/MF A01.

Preshot and postshot characterization of the Los Alamos Scientific Laboratory (LASL) Colony Oil Shale Mine experiments and the geologic parameters affecting their interpretation are discussed. Because site-specific geologic features affect explosive rock breakage strongly, all successful predictive models must take them into account explicitly. Successful fielding of the CORRTEX measuring devices to monitor explosive behavior in large-scale events has proved very useful and will become routine in future LASL field experiments. A discussion of the oil shale fracturing techniques and some preliminary results are given. Also included is a review paper (presented at the 20th US Symposium on Rock Mechanics) that gives a concise and comprehensive overview of one approach to predictive rock breakage under investigation by LASL.

10303 **(SAND—80-1651) Tar sands permeability enhancement: proceedings of a 1980 workshop.** Wayland, J.R. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Dec 1980. Contract AC04-76DP00789. 198p. (CONF-800541—). NTIS, PC A09/MF A01.

From Tar sands permeability enhancement workshop; Albuquerque, NM, USA (8 May 1980).

A workshop was held on 8 and 9 May 1980 to identify problems in the enhancement of the permeability of tar sands. The first day was devoted to a series of review papers of current methods of permeability enhancement being applied to other hydrocarbon-bearing resources. The second day's round-table discussion was restricted to tar sands permeability enhancement, with only a brief discussion of recovery processes. It was concluded that the use of standard commercial explosives was not productive. A slow-burning propellant delivering a tailored pulse would require careful study before being useful. Problems were seen with hole completion and stability if directional drilling techniques are used. The most promising approach appears to be hydraulic fracturing. Considerable effort needs to be devoted to understanding fracture behavior in cohensionless tar sands. Separate abstracts were prepared for seven of the ten papers; the remaining three had been previously abstracted. (DLC)

10304 (SAND—80-1651, pp 45-83) **Development of permeability in cohesionless bituminous sands.** Dusseault, M.B. (Univ. of Alberta, Edmonton). Dec 1980.

From Tar sands permeability enhancement workshop; Albuquerque, NM, USA (8 May 1980).

Alberta's oil sands are shallow (< 700 meteres), cohesionless, dense sands containing viscous bitumen of low gravity (6° to 12° API). Permeability development is necessary to recover oil from most reservoirs, and fracture by massive injection of air or water is being used in many pilot projects. Observed fracture phenomena in oil sands include climbing fractures, fracture direction change, cohensionless behavior, and fracture widening. Modeling behavior is complex because properties change due to remolding and heat injection. Some fracture control may be gained by careful production strategy until good communications are achieved.

10305 (SAND—80-1651, pp 157-165) **Frac-map process monitoring in the asphalt ridge tar sand, Vernal, Utah.** Wood, M.D.; Holzhausen, G.R. (M.D. Wood, Inc., Palo Alto, CA). Dec 1980.

From Tar sands permeability enhancement workshop; Albuquerque, NM, USA (8 May 1980).

Deformation of the ground surface during formation of an hydraulic fracture in a tar sand deposit in northeastern Utah provided an estimate of the strike, dip, and areal extent of the fracture. Perturbations in the deformation field suggested that fracture growth was nonuniform and that fracture branching or a change in propagation direction occurred after two-thirds of the fracturing fluid had been injected. The vertical orientation of the fracture is a gross deviation from the design fracture which was expected to remain conformal to the shallow dip of the deposit.

0404 Oil Production, Recovery, And Refining

10306 **(FE—1747-14) BX in situ oil shale project. Quarterly technical progress report, September 1, 1980-November 30, 1980.** Dougan, P.M. (Equity Oil Co., Salt Lake City, UT (USA)). 20 Dec 1980. Contract FC20-78LC10747. 205p. NTIS, PC A10/MF A01.

Activities at the BX In Situ Oil Shale Project for the quarter included 39 days of superheated steam injection; 47 days of saturated steam injection and 4 days of no injection. Total water injected as steam was 114,172 barrels while total fluids produced was 98,801 barrels. The steam was injected at an average wellhead pressure of 1272 PSIG and an average wellhead temperature of 620°F. Problems related to the operation of the Project superheater were resolved during September 1980 and the unit was placed back in service in early October 1980. The unit operated without upset during the entire month of November 1980. Temperature logs were run during the quarter confirming heat up in the Project production and temperature observation wells and based upon these surveys, production wells were perforated in the upper injection zone in October. The first production of oil from a production well (BX-26) occurred during the quarter and at the end of the quarter, modifications of the Project production facilities were underway to facilitate the recovery of the oil which is produced as an oil/water emulsion. Environmental monitoring at the Project site continued during the quarter in compliance with the established Environmental Research Plan.

10307 **Shell Pellet Heat Exchange Retorting - SPHER: an energy-intensive, energy-efficient process for retorting oil shale.** Gwyn, J.E.; Roberts, S.C.; Hardesty, D.E.; Johnson, G.L.; Hinds, G.P. Jr. (Shell Development Co., Houston, TX). *American Chemical Society, Division of Fuel Chemistry, Preprints ;* **25**: No. 3, 59-69(1980). (CONF-800814—P2).

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; Las Vegas, NV, USA (24 Aug 1980).

The purpose of this work was to develop a new retorting process of relatively low capital cost that is mechanically simple, highly reliable, and uses heat efficiently. The process, termed SPHER for Shell Pellet Heat Exchange Retorting, is a fluidization bed process conceived for the retorting of oil shale. The fluidization mode referred to in this discussion applies to a range of superficial gas velocities between those used for riser transport and dense bed operation in processes such as catalytic cracking. By this mode, shale can be made to flow upward, countercurrently to larger heat-carrier pellets that fall through the fluidized mixture. This counterflow of heat-carrier pellets and relatively coarse shale particles is the basic idea around which novel, small sized, thermally efficient and economically viable processes have been conceived. Other feedstocks to which SPHER may have potential applicability include numerous coals, lignite, wood and bark waste, agricultural residues, biotreater sludges, and industrial and municipal solid wastes. Some specific process descriptions, with some variations, are discussed. As with most newly conceived processes there is considerable development work to be done before SPHER is a mature process. This report serves to present the basic features of SPHER and to point up some areas requiring development work.

10308 (SAND—80-1651, pp 9-16) **LERC tar sand permeability enhancement.** Fahy, J.; Marchant, L.C. (Laramie Energy Tech. Center, WY). Dec 1980.

From Tar sands permeability enhancement workshop; Albuquerque, NM, USA (8 May 1980).

Pneumatic fracturing of the injection wells for the first LERC in-situ reverse combustion experiment in a Utah Tar Sand is described. The first LERC experimental hydraulic fracture is also detailed.

10309 (SAND—80-1651, pp 17-44) **Review of a hydraulic fracture test in the tar sands at Asphalt Ridge, Utah.** Jones, A.H.; Sinha, K.P.; Abou-Sayed, A.S. (Terra Tek, Inc., Salt Lake City, UT). Dec 1980.

From Tar sands permeability enhancement workshop; Albuquerque, NM, USA (8 May 1980).

Material properties and in-situ stress field information were used to design and analyze a hydraulic fracture experiment in tar sand. In-situ stress measurements performed in an adit approximately 1/4 mile (400 metres) northeast of the well indicated the horizontal stresses were comparable to the overburden. For this stress state there is no preferred fracture orientation. The induced fracture, based on the interpretation of measured tilts at the surface during fracture treatment, was deduced to lie in a near vertical plane. Recommendations are made for post-fracture investigation to ascertain the regional characteristics of the in-situ stresses.

10310 **Process for retorting oil shale.** Matthews, C.W. (to Gulf Research & Development Co). US Patent 4,222,850. 16 Sep 1980. Filed date 15 Feb 1979. vp.

This invention relates to a process for retorting raw shale comprising the following steps: (1) passing raw shale downwardly through the upper zone of a two-zoned vertical retort; (2) introducing a gas comprising molecular oxygen and flue gas at a temperature of about 590* to about 760* C., and ambient pressure into said upper zone and passing the same upwardly through said upper zone in contact with said raw shale; (3) recovering from an upper part of said upper zone a product comprising shale oil and retort gas; (4) passing the treated shale from a lower part of said upper zone downwardly through the lower zone of said two-zoned retort; (5) introducing molecular oxygen at a temperature of about 25* to about 100* C. And flue gas at a temperature of about 25* to about 200* C., and ambient pressure into said lower zone and passing the same upwardly through said lower zone in contact with said treated shale; (6) recovering from an upper part of said lower zone a preheated gas comprising molecular oxygen and preheated flue gas; and (7) recovering from a lower part of said lower zone spent

10311 **Method of processing solids-containing oils or tars.** Eisenlohr, K.H.; Simo, T. (to Metallgesellschaft Ag (Germany, Federal Republic Of)). US Patent 4,220,522. 2 Sep 1980. vp.

A process for refining a shale oil or tar fraction boiling below 200* C is described wherein the shale oil or tar fraction is hydrogenated in the presence of a pre-hydrogenated naphtha which functions as a hydrogen transfer agent. Also described is a method for the production of such pre-hydrogenated naphtha from a solid containing shale oil or tar fraction boiling above 200* C.

0406 Direct Uses And By-products

10312 **(ALO—3726-T1) Utilization of shale oil as a feedstock for steam pyrolysis and petrochemical intermediate production. Final report.** Dickson, P.F.; Yesavage, V.F. (Colorado School of Mines, Golden (USA). Dept. of Chemical and Petroleum Refining Engineering). 1 Sep 1979. Contract AS03-78ET13105. 293p. NTIS, PC A13/MF A01.

Portions of document are illegible.

The major objectives of this study were to determine the effects of prerefining on product yields for steam pyrolysis of a shale oil feed and to determine the suitability of shale oil as a petrochemical feedstock. The results of this research program have in general been highly successful. A bench scale pyrolysis reactor was designed and constructed which was used to obtain yield data for variable operating conditions in the range typically employed commercially. Two crude shale oils were used in this study, a Tosco II shale oil as an example of above ground retorting and simulated in-situ shale oil as an example of in-situ processing. Each crude oil was processed to four different levels of prerefining: vacuum distillation and hydrogenation of the vacuum distillate at three levels of severity. A total of 112 experimental runs have been performed on the 10 shale oil samples. An initial comparison of shale oil with petroleum feedstocks indicates that yields of all major gaseous components for shale oil feedstocks are comparable with yields for petroleum fractions with the exception of ethylene. Yields of ethylene are in general considerably higher for the shale oil feedstocks than for typical petroleum feedstocks. A tendency for severely hydrogenated samples to gasify is at present the major qualification to the potential advantages of using shale oil as a petrochemical feedstock. To more fully define the sutiability of shale oil and prerefined shale oil as petrochemical feedstocks more thorough investigation of the liquid products is essential. A preliminary kinetics model was developed which consists of a reaction of feed shale oil to primary products, with subsequent reaction of these products to secondary products.

10313 (CONF-800334—(Vol.1), pp 102-113) **Spent shale grouting of abandoned in-situ oil shale retorts.** Fox, J.P.; Persoff, P. (Lawrence Berkeley Lab., CA). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

Vertical modified in-situ retorting may result in in-situ leaching of abandoned retorts, overburden cracking and subsidence, and low resource recovery. These problems may be controlled by filling the abandoned retorts with a grout based on surface spent shale. A number of grouts with a range of properties have been proposed. These include production of portland cement from raw shale, development of high-strength hydraulic cement by lime addition to Lurgi spent shale, development of low-strength grout by retorting in steam at 700°C following oil recovery and char combustion, and use of as-received spent shales with various additives. These investigations suggest that untreated spent shale may be used to control in-situ leaching and subsidence. However, if additional resource recovery is required, a higher strength grout will be required.

0407 Health And Safety

REFER ALSO TO CITATION(S) 10318, 11367

0409 Waste Research And Management

REFER ALSO TO CITATION(S) 10164, 10172, 10175

10314 (CONF-800334—(Vol.1), pp 114-129) **Control technology research developments for in situ oil shale process waters.** Lotwala, J.T.; Farrier, D.S.; Poulson, R.E. (Laramie Energy Technology Center, WY). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

Development of treatment and management techniques for the water produced during in situ oil shale retorting operations is one of the most important initial steps required towards the achievement of the ultimate goal of successful commercialization. This paper identifies the three distinct water streams produced during a retorting operation and discusses treatment schemes for each type. Significant research results obtained from the current water treatment projects of the Laramie Energy Technology Center (LETC) are presented and a summary overview of water related environmental research conducted under the leadership of LETC is provided.

10315 **(DOE/LETC/10020—1) Role of spent shale in oil shale processing and the management of environmental residues. Final technical report, January 1979-May 1980.** Hines, A.L. (Colorado School of Mines, Golden (USA). Dept. of Chemical and Petroleum Refining Engineering). 15 Aug 1980. Contract AC20-79LC10020. 154p. NTIS, PC A08/MF A01.

The adsorption of hydrogen sulfide on retorted oil shale was studied at 10, 25, and 60°C using a packed bed method. Equilibrium isotherms were calculated from the adsorption data and were modeled by the Langmuir, Freundlich, and Polanyi equations. The isosteric heat of adsorption was calculated at three adsorbent loadings and was found to increase with increased loading. A calculated heat of adsorption less than the heat of condensation indicated that the adsorption was primarily due to Van der Waals' forces. Adsorption capacities were also found as a function of oil shale retorting temperature with the maximum uptake occurring on shale that was retorted at 750°C.

0410 Enviromental Aspects

10316 (CONF-800334—(Vol.1), pp 81-90) **Oil shale task force: past, present, and future.** Chappell, W.R. Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The Oil Shale Task Force is a mechanism for coordinating the environmental research being performed by various groups as part of the Data Base Subactivity of the Environmental Activity of the RD and D Plan. The Task Force approach has proven useful as a means of facilitating communication between researchers and with the user groups such as state regulatory agencies, industry and environmental groups. A considerable amount of data has been obtained leading to some important conclusions regarding the MIS process. Additional activities are underway and will be the subject of future reports.

10317 (CONF-800334—(Vol.1), pp 130-139) **Retorted oil shale management.** Cook, C.W.; Redente, E.F.; Berg, W.A.; Ruzzo, W.J. Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

This paper reports on the results and findings of a long-term ecosystem study directed toward providing guidelines for the reclamation of Colorado oil shale lands. The study, presently underway in the Piceance Basin of northwestern Colorado, is evaluating the effect of retorted shale properties and the method of disposal on various ecosystem components. The goal of this study is to develop specific recommendations for the reestablishment of ecosystems on land disturbed by retorted oil shale disposal.

10318 **(PB—80-186091) Oil shale mining environmental research program overview. Final report.** Ogasawara, C.; Kuncir, G.F.; Lewis, D.A. (Aerospace Corp., El Segundo, CA (USA)). Jun 1979. 71p. NTIS, PC A04/MF A01.

This document describes the direction and progress of the Bureau of Mines Oil Shale Mining Environmental Research Program as of January 31, 1979. It is aimed at focusing the Bureau's role in environmental research supporting oil shale development with respect to the activities of other involved government agencies and private industry. Environmental considerations in oil shale extraction, such as ecological disturbances, health and safety hazards, waste management, and socioeconomic impacts, are discussed along with the type of research known to be planned by organizations to ameliorate these problems.

05 NUCLEAR FUELS

0501 Reserves

10319 **(DOE/PR/50162—T1) Energy management manual.** (Ernst and Ernst, Washington, DC (USA)). Jun 1979. Contract AC01-76PR50162. 239p. NTIS, PC A11/MF A01.

The Pueblo of Laguna lies in the Grants Uranium Belt. The Grants belt is the source of more than half of all uranium produced in the US. Currently the Pueblo has development agreements with Conoco and Anaconda. Only the Anaconda leasehold has been developed - an open pit mine and 2 underground mines. The Pueblo has several areas of concern in managing mineral development. These include monitoring and enforcing performance standards, and taxing severance of uranium from the land. Constraints on tribal regulation of energy development are discussed in Chapter 1. Energy management program needs of the Pueblo of Laguna are discussed in Chapter 2. Chapter three contains the energy management plan to be used by the Pueblo as it formulates and implements an energy development and management strategy. (DMC)

10320 **(K/CSD/INF—80/41) Mathematical issues in subjective resource assessment.** Ford, C.E.; McLaren, R.A. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 1980. Contract W-7405-ENG-26. 29p. (CONF-801235—1). NTIS, PC A03/MF A01.

From Workshop on uncertainty in uranium resource and cost assessments; Denver, CO, USA (8 Dec 1980).

This paper contains the important mathematical procedures used in the analysis of regional and national uranium resources, in which resources estimates are represented as random variables. (DLC)

0502 Exploration

10321 **(GJBX—20(81)(Vol.2)(SanLuis)) Airborne gamma-ray spectrometer amd magnetometer survey: San Luis Obispo. Final report.** (High Life Helicopters, Inc., Puyallup, WA (USA); QEB, Inc., Lakewood, CO (USA)). 1981. Contract AC13-76GJ01664. 250p. NTIS, PC A11/MF A01.

Thirty-five uranium anomalies meet the minimum statistical requirements as defined in Volume I. These amonalies are tabulated and are shown on the uranium anomaly interpretation map, together with the interpretation of the magnetic data.

10322 **(GJBX—20(81)(Vol.2)(SantaMaria)) Airborne gamma-ray spectrometer amd magnetometer survey: Santa Maria. Final report.** (High Life Helicopters, Inc., Puyallup, WA (USA); QEB, Inc., Lakewood, CO (USA)). 1981. Contract AC13-76GJ01664. 188p. NTIS, PC A09/MF A01.

Fourteen uranium amonalies meet the minimum statistical requirements as defined in Volume I. These anomalies are tabulated and are shown on the uranium anomaly interpretation map, together with the interpretation of the magnetic data.

10323 **(GJBX—24(81)) Scranton NTMS 1° x 2° quadrangle area New Jersey, New York, and Pennsylvania: supplemental data report. National Uranium Resource Evaluation Program, hydrogeochemical and stream sediment reconnaissance.** Heffner, J.D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Nov 1980. Contract AC04-76DP00613. 15p. (DPST—78-146-6S). NTIS, PC E01/MF $3.50.

Includes 3 sheets of 48 reduction microfiche.

Supplemental analytical results for 980 stream sediment samples that were collected as part of the SRL-NURE reconnaissance in the National Topographic Map Series (NTMS) Scranton 1° x 2° quadrangle are presented. Results are reported for 19 elements (Ag, Ba, Be, Co, Cr, Cu, K, Li, Mg, Mo, Nb, Ni, P, Pb, Sn, Sr, W, Y, and Zn). Analyses are tabulated and displayed graphically on microfiche. Field data and neutron activation analysis (NAA) were open-filed in DPST-78-146-6 [GJBX-02(79)].

10324 **(GJBX—25(81)) Rome 1° x 2° NTMS area, Georgia and Alabama. Data report (abbreviated): National Uranium Resource Evaluation program, hydrogeochemical and stream sediment reconnaissance.** Cook, J.R.; Fay, W.M. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Dec 1980. Contract AC04-76DP00613. 19p. (DPST—80-146-25). NTIS, PC E02/MF $3.50.

Includes 8 sheets of 48 reduction microfiche.

Results of ground water and stream sediment reconnaissance in the National Topographic Map Series Rome 1° x 2° quadrangle are presented. Surface sediment samples were collected at 1257 sites in the Rome quadrangle. Ground water samples were collected at 813 sites. Neutron activation analysis results are given for uranium and 16 other elements in sediments, and for uranium and 8 other elements in ground water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Data from ground water sites include: (1) water chemistry measurements (pH, conductivity, and alkalinity); (2) physical measurements where applicable (water temperature, well description); and (3) elemental analyses (U, Al, Br, Cl, Dy, F, Mn, Na, and V). Data from sediment sites include: (1) stream water chemistry measurements; and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (stream characteristics, vegetation) are also tabulated. Areal distribution maps, histograms, and cumulative frequency plots for most elements and for U/Th and U/Hf ratios are included on the microfiche. Key data from stream water sites include: (1) water quality measurements (pH, conductivity, and alkalinity); and (2) elemental analyses (U, Al, Br, Cl, Dy, F, Mg, Mn, Na, and V). Uranium concentrations in the sediments ranged from 0.6 to 267.5 ppM with an average of 6.4 ppM. The highest uranium concentrations occur in the eastern one third of the quadrangle. A northeast-southwest fault divides this area into two distinct geographical regimes. To the north, high U/Th ratios are found; while to the south, high U/Hf

ratios occur. Small uranium occurrences are reported in this area in pegmatites.

10325 **(GJBX—26(81)) Johnson City 1° x 2° NTMS area, Kentucky, North Carolina, Tennessee, and Virginia: data report (abbreviated). National Uranium Resource Evaluation program, hydrogeochemical and stream sediment reconnaissance.** Fay, W.M. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Oct 1980. Contract AC04-76DP00613. 19p. (DPST—80-146-14). NTIS, PC E02/MF $3.50.

Includes 7 sheets of 48 reduction microfiche.

Results of ground water and stream sediment reconnaissance in the National Topographic Map Series (NTMS) Johnson City 1° x 2° quadrangle are presented. Surface sediment samples were collected at 959 sites. Ground water samples were collected at 1099 sites. Neutron activation analysis results are given for uranium and 16 other elements in sediments, and for uranium and 8 other elements in ground water. Data from ground water sites include: (1) water chemistry measurements (pH, conductivity, and alkalinity); (2) physical measurements where applicable (water temperature, well description, etc.); and (3) elemental analyses (U, Al, Br, Cl, Dy, F, Mn, Na, and V). Data from sediment sites include: (1) stream water chemistry measurements; and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (stream characteristics, vegetation, etc.) are given. Areal distribution maps, histograms, and cumulative frequency plots for most elements and for U/Th and U/Hf ratios are included on the microfiche. The Johnson City Quadrangle is underlain by Precambrian cyrstalline rocks in the southeastern corner of the quadrangle and by Paleozoic sediments in the remainder of the quadrangle. The highest uranium concentrations in sediments (up to 22 ppM) are in samples from the Precambrian crystalline rock areas. These samples also have high thorium concentrations suggesting that most of the uranium is in resistate minerals such as monazite. The U/Th ratios in sediment samples are generaly low with the higher values (up to 2.07) mostly within the lower Paleozoic sediments, particularly the Copper Ridge Dolomite. The uranium concentration in ground water is also highest in the lower Paleozoic sediments.

10326 **(GJBX—27(81)) Dothan, Waycross, and Brunswick 1° x 2° NTMS areas, Georgia: data report (abbreviated). National Uranium Resource Evaluation program, hydrogeochemical and stream sediment reconnaissance.** Cook, J.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Dec 1980. Contract AC04-76DP00613. 19p. (DPST—80-146-26). NTIS, PC E02/MF $3.95.

Includes 12 sheets of 48 reduction microfiche.

Results of partial ground water and stream sediment reconnaissance in the National Topographic Map Series (NTMS) Dothan, Waycross, and Brunswick 1° x 2° quadrangles are presented. Sediment samples were collected at 34, 76, and 27 sites in the Dothan, Waycross, and Brunswick quadrangles, respectively. Ground water samples were collected at 51, 905, and 233 sites in the Dothan, Waycross, and Brunswick quadrangles, respectively. Neutron activation analyses results are given for uranium and 16 other elements in sediments, and for uranium and 8 other elements in ground water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented. Data from ground water sites include: (1) water chemistry measurements (pH, conductivity, and alkalinity); (2) physical measurements where applicable (water temperature, well description); and (3) elemental analyses (U, Al, Br, Cl, Dy, F, Mn, Na, V, and, when available, He). Areal distribution maps, histograms, and cumulative frequency plots for most elements for ground water in the Waycross quadrangle are included. Data from sediment sites include: (1) stream water chemistry measurements; and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (stream characteristics, vegetation, etc.) are also tabulated. Uranium concentrations in the sediments ranged from 1.6 to 36.2 ppM with an average of 6.2. Uranium concentrations in ground water samples ranged from 0.001 to 1.33 with an average of 0.07 ppB.

10327 **(GJBX—28(81)) Aerial gamma ray and magnetic survey: Centerville quadrangle, Iowa and Missouri. Final Report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). Nov 1980. Contract AC04-76DP00613. 243p. NTIS, PC E09/MF $3.65.

The Centerville quadrangle covers approximately 7250 square miles of the northeastern Forest City Basin adjacent to the Mississippi Arch. Mississippian and Pennsylvanian sediments are mapped exclusively over the entire surface. A search of available literature revealed no known uranium deposits. A total of one hundred ten (110) uranium anomalies were detected and are discussed briefly in this report. None were considered significant and all appear to be related to cultural features. Magnetic data appear to suggest complexities in the Precambrian material underlying the Paleozoic strata.

10328 **(GJBX—29(81)) Aerial gamma ray and magnetic survey: Moberly quadrangle, Missouri. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). Nov 1980. Contract AC04-76DP00613. 247p. NTIS, PC E09/MF $3.65.

The Moberly quadrangle covers approximately 7400 square miles in northern Missouri, overlying the eastern Forest City Basin area. The basin contains Paleozoic sediments ranging in age from Cambrian to Pennsylvanian in this area, but mainly Pennsylvanian age material is exposed as mapped. A search of available literature revealed no known uranium deposits. A total of 107 uranium anomalies were detected and are discussed briefly. All appear to be related to cultural features. Those that correlate with areas of coal mining may have some significance. Magnetic data appear to correlate directly with the underlying Precambrian material.

10329 **(GJBX—30(81)) Aerial gamma ray amd magnetic survey: Muncie quadrangle, Indiana and Ohio. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). Dec 1980. Contract AC04-76DP00613. 245p. NTIS, PC E09/MF $3.65.

The Muncie quadrangle covers some 7250 square miles of area in Indiana and Ohio within the Midwestern Physiographic Province. The region contains a thin to moderately thick section of Paleozoic sediments which are almost entirely covered by surficial Pleistocene glacial deposits. No known uranium deposits are known to occur in the quadrangle. Radiometric data appear to reflect the glacial history of the area. The average concentrations of potassium, uranium, and thorium are moderate at best. All anomalies appear culturally induced, and none appear to represent significant concentrations of uranium. The magnetic data appear to principally reflect the depth to, and complexities of, the Precambrian basement.

10330 **(GJBX—31(81)) Aerial gamma ray and magnetic survey: Chicago quadrangle, Indiana, Illinois, and Michigan. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). Dec 1980. Contract AC04-76DP00613. 260p. NTIS, PC E10/MF $3.65.

The Chicago quadrangle covers approximately 6000 square miles of area in the extreme northeastern portion of the Midwestern Physiographic Providence. Within this area, a moderately thick lower Paleozoic section overlies the Precambrian basement. Wisconsinan glacial material comprises the majority of material exposed at the surface. A search of available literature revealed no known uranium deposits. A total of 34 uranium anomalies were detected and are discussed briefly. None were considered significant since all appear to be related to cultural features. The magnetic data appear to primarily reflect complexities in the Precambrian basement.

10331 **(GJBX—32(81)) Interpretation of NURE aerial radiometric and hydrogeochemical and stream sediment reconnaissance data. Final report.** Saunders, D.F.; Jordt, D.K.; Galbraith, J.H. (Texas Instruments, Inc., Dallas (USA)). Oct 1980. Contract AC13-76GJ01664. 110p. NTIS, PC A06/MF A01.

Aerial Radiometric Reconnaissance (ARR) data packages for 124 selected 1-degree-by-2-degree NTMS quadrangles and Hydrogeochemical and Stream Sediment Reconnaissance (HSSR) data packages for 94 priority quadrangles were prepared and delivered to Bendix Field Engineering Corporation for use by NURE quadrangle evaluation teams. Copies of the ARR maps and HSSR data

books will be placed on file at the Bendix Field Engineering Corporation Technical Library in Grand Junction, Colorado. Additional studies were performed to investigate environmental influences on the sensitivity of aerial gamma-ray spectrometer surveys and on the apparent surface geochemical behavior of uranium, thorium, and potassium. Results reported by Norwine, et al., (1979) indicated that the sensitivities of aerial gamma-ray measurements, as compared with measurements on fresh rocks, decreased by as much as factors of 3 to 5 in very humid climates, apparently due to surface leaching of the elements or daughters and soil-moisture or vegetation absorption of the gamma radiation. Results of studies aimed at finding possible quantitative relationships between the ARR data or the HSSR data parameters for whole quadrangles and uranium resources in the quadrangles are summarized. Workable relationships were discovered that allow the radiometric and geochemical data in the conterminous United States to be used to predict uranium inventories in tons of U_3O_8 for comparison with US Department of Energy estimates for that quantity. In Alaska, it was possible to relate the regional aerial radiometric data to uranium potential measured in terms of numbers of significant local high uranium anomalies.

10332 **(GJBX—35(81)(Vol.1)) Aerial radiometric and magnetic survey; Brushy Basin detail survey: Price/Salina national topographic map sheets, Utah. Volume I. General narrative report. Final report.** (Geodata International, Inc., Dallas, TX (USA)). 1981. Contract AC13-76GJ01664. 342p. NTIS, PC E09/MF $20.75.

Includes 122 sheets of 48 reduction microfiche.

The results of the analyses of a systematic airborne gamma radiation and total magnetic survey for the area identified as Brushy Basin, located in central Utah, are presented in Volumes I-IV of this report. The airborne data gathered is reduced by ground computer facilities to yield profile plots of the equivalent uranium, thorium and potassium gamma radiation intensities, the ratios of these intensities, the total gamma radiation counting rate and the earth's residual magnetic field intensity. Profile plots of the aircraft's altitude above the earth's surface, the ambient temperature and pressure, and the magnetic field data measured by a base station magnetometer are presented also. An evaluation of the distribution of the radiometric data in terms of surface geology and its established geochemical units, which were derived via geochemical analysis methods, for the entire survey area has been prepared and is included. The determination of the geochemical units presented has been established principally from the analysis of the radiometric and magnetic contour maps and, more importantly, the multi-variate analysis map. A general description of the area, including descriptions of the various geologic and geochemical units, is inluded within the text.

10333 **(GJBX—35(81)(Vol.2)) Aerial radiometric and magnetic survey; Brushy Basin detail survey: Price/Salina National Topographic Map Sheets, Utah. Volume II. Area I-graphic data. Final report.** (Geodata International, Inc., Dallas, TX (USA)). 1981. Contract AC13-76GJ01664. 406p. NTIS, PC A18/MF A01.

This volume contains all the graphic data for Area I, which includes map lines 20 to 1560 and the lines 6020 to 6060. Due to the large map scale of the data presented, this area was further subdivided into nine 7-1/2 minute quadrant sheets. Included in this volume are multi-variable radiometric stacked data profiles, magnetic and ancillary stacked data profiles, radiometric and magnetic control maps, multi-variant map, geochemical analysis map, geochemical flight line composite map, geologic base map, and geologic flight line composite map.

10334 **(GJBX—35(81)(Vol.4)) Aerial radiometric and magnetic survey; Brushy Basin detail survey: Price/Salina national topographic map sheets, Utah. Volume IV. Area III: graphic data. Final report.** (Geodata International, Inc., Dallas, TX (USA)). 1981. Contract AC13-76GJ01664. 333p. NTIS, PC A15/MF A01.

This volume contains all the graphic data for Area III, which includes lines 3420 to 5320 and tie lines 6080, 6100, and 6140. Due to the large map scale of the data presented (1:62,500), this area was further subdivided into eleven 7-1/2 min quadrant sheets.

10335 **(GJBX—37(81)) Geological study of uranium potential of the Kingston Peak Formation, Death Valley Region, California.** Carlisle, D.; Kettler, R.M.; Swanson, S.C. (California Univ., Los Angeles (USA). Dept. of Earth and Space Sciences). Sep 1980. Contract AC13-76GJ01664. 136p. NTIS, PC A07/MF A01.

The results of a geological survey of the Kingston Peak Formation on the western slope of the Panamint Range near Death Valley are discussed. The geology of the Panamint mountains was mapped on topographic base maps of the Telescope Peak and Manly Peak quadrangles. Radiometric suveys of the area were conducted using gamma ray spectrometers. Samples of the conglomerate were analyzed using delayed neutron, neutron activation, atomic absorption, and LECO analysis. It is concluded that uranium mineralization in the Favorable Submember is significant and further exploration is warranted. The monazite-fenotime related uranium and thorium mineralization in the Mountain Girl quartz pebble conglomerate is of no economic interest. (DMC)

10336 **(IS—4756) Multilaboratory quality control report for the hydrogeochemical and stream sediment reconnaissance. Final report.** D'Silva, A.P.; Grabau, F.; Haas. W.J. Jr. (Ames Lab., IA (USA)). Oct 1980. Contract W-7405-ENG-82. 272p. NTIS, PC A12/MF A01.

Quality control batches of water and sediment samples were sent to four participating laboratories the first of every month: Los Alamos Scientific Laboratories (LASL), Lawrence Livermore Laboratory (LLL), Oak Ridge National Laboratory (ORNL), and Savannah River Laboratory (SRL). These four laboratories were designated to conduct extensive field surveys for locating potential uranium deposits in this country and in the process expected to collect and process nearly a million and a half water and stream sediment samples. Control charts of all determinations reported to AL are included in this final report along with histograms of monthly statistics for each laboratory. Figures of interlaboratory comparison of aggregate means of each control batch are included as an overview of the performance of each laboratory over the lifetime of the program (1976 to 1980).

10337 **(K/UR—44) Application of Kriging to hydrogeochemical data from the National Uranium Resource Evaluation Program.** Myers, D.E.; Begovich, C.L.; Butz, T.R.; Kane, V.E. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Dec 1980. Contract W-7405-ENG-26. 335p. NTIS, PC E11/MF $3.50.

Includes 1 sheet of 48 reduction microfiche.

The Hydrogeochemical and Stream Sediment Reconnaissance (HSSR) Program is an important part of the data collection segment of the NURE Program. This report presents the preliminary results of applying a new geostatistical tool, known as Kriging, to HSSR data from the Plainview Quadrangle in Texas. The essential conclusion of this report is that Kriging can be useful in characterizing geochemical data and identification of the anomalous geographic regions used in resource appraisal. Computer codes were prepared for use either on other variables or stream sediment data and/or data from other quadrangles. Several ways of using Kriging to enhance HSSR data for the purpose of identifying favorable areas were identified.

10338 **(LA—8017-MS) Uranium hydrogeochemical survey of well waters from an area around Pie Town, Catron County, West-Central New Mexico, including concentrations of twenty-three additional elements.** Morgan, T.L.; George, W.E.; Hensley, W.K.; Thomas, G.J.; Langhorst, A.L. (Los Alamos Scientific Lab., NM (USA)). Oct 1980. Contract W-7405-ENG-36. 74p. NTIS, PC A04/MF A01.

As part of the Hydrogeochemical and Stream Sediment Reconnaissance (HSSR) of the National Uranium Resource Evaluation (NURE) sponsored by the US Department of Energy (DOE), the Los Alamos Scientific Laboratory (LASL) conducted a detailed hydrogeochemical survey of well waters in a 4250-km^2 area near Pie Town in west-central New Mexico. A total of 300 well samples was collected and analyzed for uranium and 23 other elements. The results of these analyses and carbonate and bicarbonate ion concentrations are presented in the Appendixes of this report. Uranium concentrations range from below the detection limit of 0.02 parts

per billion (ppB) to 293.18 ppB and average 8.71 ppB. Samples containing high levels of uranium were collected from the Largo Creek valley west of Quemado, from a small area about 6 km east of Quemado, from a small area surrounding Pie Town, and from scattered locations in the area surrounding Adams Diggings north of Pie Town. Most of the samples containing high uranium concentrations were collected from wells associated with the volcanic sedimentary facies of the Datil formation. This formation is a likely source of mobile uranium that may be precipitating in the underlying Baca formation, a known uranium host unit. Bicarbonate ion concentration, while proportional to uranium concentration in some cases, is not a strong controlling factor in the uranium concentrations in samples from this area.

10339 **(GJBX—35(81)(Vol.3)(Sect.3-9)) Aerial radiometric and magnetic survey; Brushy Basin detail survey: Price/ Salina national topographic map sheets, Utah. Volume III. Area II: graphic data, Section III-IX Final report.** (Geodata International, Inc., Dallas, TX (USA)). 1981. Contract AC13-76GJ01664. 523p. NTIS, PC A21/MF A01.

This volume contains all of the graphic data for Area II, which include map lines 1660 to 3400 and 5360 to 5780 and tie lines 6100, 6120, and 6160. Due to the large map scale of the data presented (1:62,500), this area was further subdivided into eleven 7-1/2 min quadrant sheets. It should be noted that TL6100 resides in both Areas II and III. The graphic data for TL6100 are presented in Volume IV - Area III - Graphic Data of this report.

10340 **(GJBX—35(81)(Vol.3)(Sect.1-2)) Aerial radiometric and magnetic survey; Brushy Basin detail survey: Price/ Salina national topographic map sheets, Utah. Volume III. Area II: graphic data, Section I-II. Final report.** (Geodata International, Inc., Dallas, TX (USA)). 1981. Contract AC13-76GJ01664. 374p. NTIS, PC A16/MF A01.

This volume contains all of the graphic data for Area II which consists of map lines 1660 to 3400 and 5360 to 5780, and tie lines 6100, 6120, and 6160. Due to the large map scale of the presented data (1:62,500), this sub-section was divided into eleven 7-1/ 2 min quadrant sheets.

10341 **Analytical methodology for uranium exploration: retrospective and prospective.** Ward, F.N. (Geological Survey, Denver, CO); Price, V. *Journal of Geochemical Exploration ;* **13**: No. 2/3, 97-113(Nov 1980).

Conventional fluorometric and delayed-neutron counting techniques are those most widely used in geochemical exploration for uranium. Other techniques such as those based on x-ray fluorescence, laser-induced fluorescence and nuclear-fission track measurements are used to a lesser extent, but all have unique capabilities and may indeed experience greater use depending on sensitivity required, sample media, chemical form of uranium or associated daughter products, turnaround time, and initial costs of equipment. Techniques have been developed for rapid, automated, neutron activation analysis (NAA) of sediment and water samples for uranium and as many as 20 other elements. Uranium in water samples is extracted in the field onto ion exchange resin which is later analyzed by NAA. Tests show nearly complete removal of dissolved materials in most waters and selective removal of uranium even from high-conductivity waters. Amid the overwhelming proliferation of instruments controlled by microprocessors for determining uranium in geologic materials, problems and limitations remain and when the instruments fail, a skilled analyst can use one of several analytical procedures, albeit at a reduced output and greater expense.

10342 **Management and analysis of regional geochemical data.** Garrett, R.G. (Geological Survey of Canada, Ottawa, Ontario); Kane, V.E.; Zeigler, R.K. *Journal of Geochemical Exploration ;* **13**: No. 2/3, 115-152(Nov 1980).

Experiences in the US National Uranium Resource Evaluation Program and Canadian Uranium Reconnaissance Program related to the use of geochemical exploration methods are drawn upon to review concepts and standards for data management and analysis. The topics discussed include: (1) field data acquisition; (2) quality control; (3) data management; (4) univariate statistical analysis; (5) initial data presentation; (6) multivariate statistical analysis; and (7) derivative maps. It is concluded that computer usage is essential if the data are to be compiled to desired levels of quality assurance in a timely and efficient fashion for interpretation and distribution. In general the costs for data management and analysis are some 10% of total costs; of this 10% some three-quarters is expended on compilation, quality control, editing and archiving. The use of the mathematical and statistical methods, with appropriate presentation techniques, can greatly assist the geochemist in interpretation. The objective of geochemical data analysis in the context of this paper is to identify that small proportion of the samples which relate to mineralization. A variety of tools, both simple and complex, are illustrated and discussed from this viewpoint. However, it is stressed that data analysis is only a tool and the results must be critically reviewed in terms of their geochemical implications before acceptance and incorporation into an interpretation.

10343 **Geochemical exploration models for sedimentary uranium deposits.** Rose, A.W.; Wright, R.J. (Pennsylvania State Univ., University Park). *Journal of Geochemical Exploration ;* **13**: No. 2/3, 153-179(Nov 1980).

The geochemical detection of uranium deposits in sedimentary rocks, especially sandstone-type deposits, depends on the geochemical behavior of U and pathfinder elements. Uranium is extensively dispersed under oxidizing conditions but is immobile under reducing conditions. Adsorption on freshly precipitated Fe-oxides and certain types of organic matter also limits dispersion unless high concentrations of CO_3^{2-} or other complexers are present. Thorium accompanies U in most plutonic processes, but the two elements are separated under oxidizing conditions. Background values for U in water are increased by evaporation and transpiration in arid regions, and are low because of extensive leaching in humid regions. Possible pathfinder elements associated with U in sandstone-type deposits include S, V, Mo, Se, As and at some deposits Cu, Ag, Cr, Pb, Zn, Ni, Co, Re, Be, P, Mn and rare earths, plus He, Rn and other radioactive decay products. Exploration models must take into account channelling of dispersion and possible concealment of deposits by bedding in sedimentary rocks. Most uranium deposits in sedimentary rocks are associated with geochemical provinces enriched in U and Th or with U-rich intrusives or volcanic rocks. However, the deposits may be separated from these U-rich source rocks by tens of kilometers or more. Halos of anomalous U and small concentrations of U are present around many U deposits but have not been documented in detail. Anomalies in U, Se, Mo, V, As, He, Rn, and other pathfinder elements in rock and in ground and surface waters can furnish geochemical guides to ore, as can thermoluminescence, S and C isotopes, and textures of Fe and Ti oxides.

10344 **Geochemical exploration for uranium in Playas.** Leach, D.L. (Geological Survey, Denver, CO); Puchlik, K.P.; Glanzman, R.K. Contract W-7405-ENG-48. *Journal of Geochemical Exploration ;* **13**: No. 2/3, 251-283(Nov 1980).

Playas and closed-basin lakes represent unique geochemical environments for the entrapment and concentration of mobile chemical elements. For this reason, playas may be considered as potentially favorable areas for the accumulation of uranium. We investigated playa sediments to determine their value as possible sample media for determining the presence of accumulations of uranium in the basins and playas. Instrumental neutron activation analyses were made on near-surface [0 to 50 ft (0 to 15 m)] sediments, pore fluids, and both surface and groundwater in closed basins at Winnemucca Dry Lake, Smoke Creek Desert, Roach Lake, Columbus Marsh, and Clayton Valley, Nevada, and Sevier Lake, Utah. Although playa sediments at spring discharge areas contain as much as 58 ppM uranium, evaporation and mobilization processes were found to limit the usefulness of playa sediments as geochemical sampling media for uranium. Other metals, however, such as zinc, tungsten, and gold may have a geochemical signature in the playas. Most playas have little potential for resources of uranium.

10345 **Stream sediment geochemical surveys for uranium.** Price, V.; Ferguson, R.B. (Savannah River Lab., Aiken, SC). Contract AC09-76SR00001. *Journal of Geochemical Exploration ;* **13**: No. 2/3, 285-304(Nov 1980).

One of the major objectives of the National Uranium Resource Evaluation (NURE) program (sponsored by the U.S. Department of Energy) is to identify areas favorable for commercial

recovery of uranium. One phase of this program is Hydrogeochemical and Stream Sediment Reconnaissance (HSSR) of the contiguous forty-eight states and Alaska. Stream sediment is more universally available than ground- and surface waters and comprises the bulk of NURE samples. Orientation studies conducted by the Savannah River Laboratory indicate that several mesh sizes can offer nearly equivalent information. Sampling densities usually vary with survey objectives and types of deposits anticipated. Analyses for elements known to be associated with uranium in a particular mineral host may be used to estimate the relative proportion of uranium in several forms. Various schemes may be used to estimate the form of uranium in a sample. Simple elemental ratios are a useful first approach. Multiple ratios and subtractive formulas empirically designed to account for the presence of particular minerals are more useful. Residuals calculated from computer-derived regression equations or factor scores appear to have the greatest potential for locating uranium anomalies.

10346 **Mineral prospecting by the detection of radon or iodine.** Macourt, D.J. US Patent 4,221,482. 9 Sep 1980. vp.

A method of detecting the presence of a coating of gaseous molecules on the surface of solid particulate material comprises the steps of entrapping the particulate material in a chemically inert carrier gas, heating the said material to release the gaseous molecules adsorbed on the particles, separating the particles from the carrier gas and the previously adsorbed gas molecules, passing the gases to a plasma, and spectroscopically analyzing the light emitted therefrom to detect the presence of the previously adsorbed gas.

0503 Mining

10347 **In-situ leach mining method using branched single well for inputand output .** Larson, W.C.; Morrell, R.J. (to U S Of America Interior Secretary Of). US Patent 4,222,611. 16 Sep 1980. Filed date 16 Aug 1979. vp.

A method and apparatus for in-situ leach mining which utilizes multiple downhole branch wells whipstocked off a single main generally vertical well. Initially the vertical well is drilled into the earth so that it may intersect the ore zone of material to be recovered. The vertical well may be cased and cemented after drilling. Thereafter from this same well a plurality of branch wells are whipstocked or drilled which intersect the vertical well at an angle from about 2 degrees to 60 degrees. These branch wells extend into the ore zone. A submersible pump and drop pipe are placed in the main well and at some point below the intersection of the main well with the branch wells a packer is placed around the drop pipe. The drop pipe carries solutions to the surface from the pump. Leaching solutions are forced or injected in the main well in the volume between the exterior surface of the drop pipe and well hole or casing so that upon encountering the branch wells and packer their solutions are forced into the branches and out into the ore body. After exiting near the opened ends (Or well screens) of the branch wells into the ore zone, the leaching solution dissolves the mineral values and the solution flow with its entrapped minerals is forced by the action of the pump through the ore zone towards the vertical well, where the solution is pumped up to the surface, via the inner drop pipe.

0504 Feed Processing

10348 **Descriptive documentation for New Mexico uranium milling model.** Bonem, G.; Livevano, R.J. Sante Fe, NM; EMIS, Resource and Development Div., State of New Mexico (1981). 41p. (NP—25233).

The New Mexico Uranium Milling Model is a linear programming model. It can demonstrate how cost minimizing management can reduce the costs of milling uranium subject to a series of environmental, resource, and technological constraints. For example, if 15,000 tons were the targeted level of milling output, the model would provide the minimum cost of this production level, given certain levels of environmental, fuel, water, and technological constraints. The model was developed to allow state policymakers to assess the uranium industry from various standpoints. Through the use of the model, state policymakers can determine the effects of air and water discharge standards and limited capital availability on: milling costs of production; uses of electricity, fuel, and water; and levels of air and water emissions. The model covers the following: process technologies which are acid leach and carbonate leach; raw materials mix; air and water discharges; residual treatment process; and plant types.

0505 Enrichment

REFER ALSO TO CITATION(S) 10353

10349 **(K/CSD/INF—80/12) RAPTS: Recycle Assembly Parts Traceability System.** Dowell, N.E. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Oct 1980. Contract W-7405-ENG-26. 73p. NTIS, PC A04/MF A01.

This paper documents the development cycle of the Recycle Assembly Parts Traceability System (RAPTS). RAPTS maintains historical explosion and implosion traceability of assemblies, as well as key pieces of manufacturing, quality assurance, inspection, and performance data. This system is being implemented in support of the centrifuge test facility operation at the Oak Ridge Gaseous Diffusion Plant operated by Union Carbide Corporation, Nuclear Division for the Department of Energy. RAPTS was designed to allow maximum flexibility to the user. Data assembly patterns and data items to be stored are defined to the system by the user. Therefore, the user can alter data storage requirements as needed without computer programmer assistance. RAPTS was designed using linked lists for actual data storage. Indexes are maintained as data entrance tools. Although RAPTS was designed to support a specific project, the software package could be used in support of any manufacturing research project due to the degree of control given the user.

10350 **Apparatus for the separation of isotopes by the separating nozzle process.** Wenzel, W. (to Nustep Trenndusen Entwicklungs & Patentverwertung Gmbh Kg & Co (Germany, Federal Republic Of)). US Patent 4,222,752. 16 Sep 1980. vp.

An apparatus for isotope separation has a plurality of separating stages connected in a separation cascade. Each of the stages has a separating-nozzle unit and a heat exchanger connected upstream of the unit for abstracting heat from the compressed gas forced through said unit. According to the invention the apparatus comprises a substantially cylindrical vessel having a generally horizontal axis and is subdivided internally by a plurality of diametral partitions defining chambers between them, each of the chambers receiving a respective one of said stages. All of the heat exchangers are in line with one another and are all at the same level in said vessel, the heat exchangers having common heat exchanger tubes extending substantially the length of the vessel through all of the chambers and through the partitions.

0507 Fuels Production And Properties

10351 **Solid solution carbide nuclear fuels.** Fleischer, L.R. (to Westinghouse Electric Corp). US Patent 4,220,614. 2 Sep 1980. Filed date 4 Apr 1967. vp.

A powder compact of mixed zirconium, carbon and uranium monocarbide powders is heated to melt first the zirconium constituent. The liquid zirconium reacts with the solid phases by a diffusion controlled process to form zirconium carbide and a (U,Zr)c solution. The compact is then heated to a higher temperature to melt the uranium monocarbide to form additional (U,Zr)c solid solution whereby the final product is composed of a single phase homogeneous solid solution.

10352 **Simulated neutron tomography for nondestructive assays.** Kruger, R.P.; Morris, R.A. (Los Alamos Sci Lab, NM). *SPIE (Society of Photo-Optical Instrumentation Engineers) Seminar Proceedings ;* **182**: 158-163(1979).

The feasibility was investigated of using resonance-energy neutron beams to generate tomographic images of fissile materials. A simulation study has indicated the potential value of this technique for the nondestructive inspection of sealed radioactive containers. 3 refs.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 11311

10353 (CONF-800334—(Vol.2), pp 66-89) **Uranium enrichment and the environment.** Wing, J.F. (Dept. of Energy, Oak Ridge, TN). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The three gaseous diffusion plants comprise one of the largest industrial complexes in the free world. Since all of the enrichment is done inside a very large plumbing maze, the control of radioactivity does not present a serious problem. Conventional, nonexotic engineering and administrative measures adequately control the minor levels of radioactivity associated with support activities such as equipment decontamination and maintenance. The treatment and control of chemical waste streams to comply with Federal and state regulations has required the commitment of 47 million dollars since 1974. Through 1982, an additional 84 million dollars may be required. The high cost is not a reflection of initially poor conditions but is rather the result of providing large treatment systems to meet very low discharge limits. Examples that will be discussed include airborne particulate removal, recirculating cooling water treatment, and hazardous waste disposal concepts.

0509 Transport And Storage

10354 **(AGNS—35900-1.1-106) Studies and research concerning BNFP: cask handling equipment standardization.** McCreery, P.N. (Allied-General Nuclear Services, Barnwell, SC (USA)). Oct 1980. Contract AC09-78ET35900. 228p. NTIS, PC A11/MF A01.

This report covers the activities of one of the sub-tasks within the Spent LWR Fuel Transportation Receiving, Handling, and Storage program. The sub-task is identified as Cask Handling Equipment Standardization. The objective of the sub-task specifies: investigate and identify opportunities for standardization of cask interface equipment. This study will examine the potential benefits of standardized yokes, decontamination barriers and special tools, and, to the extent feasible, standardized methods and software for handling the variety of casks presently available in the US fleet. The result of the investigations is a compilation of reports that are related by their common goal of reducing cask turnaround time.

10355 **(AGNS—35900-1.4-115) Studies and research concerning BNFP: transportation of radioactive material by water.** Anderson, R.T. (Allied-General Nuclear Services, Barnwell, SC (USA)). Nov 1980. Contract AC09-78ET35900. 116p. NTIS, PC A06/MF A01.

Currently there are many limitations imposed on the shipment of radioactive material from nuclear power plants. In this regard, many questions have arisen related to the feasibility of substituting water transportation of these materials as a backup or supplement to the highway and rail modes which are now in use. This study addresses the results of studies performed by Allied-General Nuclear Services concerning the water transportation of spent nuclear fuel and radwaste materials. The report presents both an overview of the possible applications, problems, and means of solution, and specific information related to one particular site. In particular, a detailed case study of a nuclear plant site located on a navigable waterway (Chesapeake Bay) was made. The study concludes that there are some real advantages in using water transport, which are particularly evident if a site is not served by rail or its primary transport route lies near populous areas. Whereas, water transport has been used extensively in Europe and Japan, it has been virtually bypassed in the United States. A recommendation is made to continue examination of water transport, including the development of necessary standards for possible future operations.

10356 **(DOE/SR-SF—2005-12) Monthly Away-From-Reactor spent fuel storsge report AFR program, December 1-31, 1980.** (Department of Energy, Aiken, SC (USA). Savannah River Operations Office). 1981. 113p. NTIS, PC A06/MF A01.

The work breakdown structure (WBS) of the Away-From-Reactor spent fuel storage program (AFR) has the following major tasks: planning and management; facility acquisition; legislative requirements; technical support; transportation; and international activities. Each task has several subtasks or activities which are covered in this report. Section 1 is a summary of monthly activities and section 2 gives the objective and status of each active subtask and includes work and milestone charts. A glossary of AFR acronyms is included.

10357 **(PB—80-811490) Hazardous materials transportation: radioactive materials and wastes. 1964-May, 1980 (citations from the NTIS data base). Report for 1964-May 80.** Carrigan, B. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 206p. NTIS PC N01/MF N01.

The bibliography cites studies on the hazards, risks, and uncertainty of transporting radioactive wastes and materials. The design of shipping containers and special labels for identification purposes for transporting fuels and wastes are also cited. Studies are included on legislation dealing with the safety and health of the population and the environmental problems associated with transporting radioactive materials. (This updated bibliography contains 195 abstracts, 28 of which are new entries to the previous edition.)

0510 Marketing And Economics

REFER ALSO TO CITATION(S) 11597

10358 **(MIT-EL—80-014) International uranium market.** Neff, T.L.; Jacoby, H.D. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Dec 1980. Contract AS02-77ET33007. 196p. NTIS, PC A09/MF A01.

The international uranium market is affected by many of the same concerns that now attend all trade in energy: the adequacy of the resource base, price uncertainty, and worries about security of access. Uranium, like energy generally, is now a strategic commodity for reasons of economic security. Uranium is also the subject of international security concerns because of its association with the proliferation of nuclear weapons. Proliferation is a subject of disagreement among nations - with some arguing that access to uranium or enriched fuel should be coupled to restraint in technological decisions and acceptance of wide-ranging safeguards; the net result is yet another dimension of uncertainty about an energy commodity that many nations feel is vital to their future. These security concerns are related to the nature and behavior of the international market for nuclear fuels. Without adequate information, the worst is usually assumed. Thus, a clearer view of the nature of supply and demand, of government policy formulation, and of market functioning can help relieve at least some of the security worries felt by those in charge of national energy policies. It is the purpose of this paper to improve this understanding. The following topics are discussed: Uranium Demand; Uranium Supply; Major Uranium Producers - Australia, Canada, South Africa, Namibia, Niger; Major Consumers - Japan, France, West Germany; The Uranium Market; and Issues and Implications.

0520 Waste Management

10359 (CONF-800334—(Vol.2), pp 117-130) **Decontamination of transuranically contaminated metallic waste.** Bennett, W.S. (Rockwell International, Golden, CO); Taboas, A.L. Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

Decontamination of metallic TRU wastes to the point where they can be managed as low level wastes is technically feasible and economically desirable. In the past, decontamination technology has concentrated on surface washes which are seldom sufficient to classify the washed object as low level waste. Recent developments which concentrate on removing the outer metal surface layers produce far more effective decontamination. Facilities presently under design are incorporating several of these newer processes. These advanced processes are in various stages of development, ranging from laboratory feasibility to full scale demonstrations. Five new decontamination facilities are being designed and will utilize the decontamination technology reviewed here.

10360 (CONF-800334—(Vol.2), pp 162-175) **Stabilization of uranium mill tailings with asphalt emulsion.** Hartley, J.N.; Koehmstedt, P.L.; Esterl, D.J.; Freeman, H.D. Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

Uranium mill tailings pose a potential radiation health hazard to the public. Therefore, stabilization or disposal of these tailings in a safe and environmentally sound way is needed to minimize radon exhalation and other environmental hazards. One of the most promising concepts for stabilizing U tailings is the use of asphalt emulsion to contain radon and other hazardous materials within uranium tailings. This approach is being investigated at the Pacific Northwest Laboratory. Results of these studies indicate that a radon flux reduction of greater than 99% can be obtained using either a poured-on/sprayed-on seal (3.0 to 7.0 mm thick) or an admixture seal (2.5 to 12.7 cm thick) containing about 18 wt % residual asphalt. A field test was carried out in June 1979 at the Grand Junction tailings pile in order to demonstrate the sealing process. A reduction in radon flux ranging from 4.5 to greater than 99% (76% average) was achieved using a 15.2-cm (6 in.) admix seal with a sprayed-on top coat. A hydrostatic stabilizer was used to apply the admix. Following compaction, a spray coat seal was applied over the admix as the final step in construction of a radon seal. Overburden was applied to provide a protective soil layer over the seal. Included in part of the overburden was a herbicide to prevent root penetration.

10361 (CONF-800334—(Vol.2), pp 176-204) **Research on radon flux reduction from uranium mill tailings.** Overmyer, R.F. (Ford, Bacon and Davis Utah, Inc., Salt Lake City); Thamer, B.J.; Nielson, K.K.; Rogers, V.C. Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

Radon flux reduction from tailings may be accomplished by the use of an impermeable cover to contain the radon until it decays (half life is 2.8 days). The use of a thick, relatively impermeable cover can attenuate radon flux because a large fraction of the radon would decay before it diffuses through the cover into the atmosphere. This method of reducing radon flux may require soil cover thicknesses on the order of 10 feet. In some locations, obtaining 10 feet of soil to cover 200 acres of tailings may be difficult or may lead to other significant environmental impacts. The Department of Energy is sponsoring research to identify alternatives to thick soil covers for reducing radon flux from uranium tailings to meet the forthcoming standards. The two most effective and practical materials tested thus far are Calcilox and asphalt emulsion. Currently, asphalt emulsions are being tested at the Grand Junction tailings pile in Grand Junction, Colorado, by Battelle Pacific Northwest Laboratory. Other asphalt formulations, such as foamed asphalt that requires less water than asphalt emulsions, may be practical and will be tested this year. Some sulfur-based materials and sulfur-extended asphalt also appear promising and will be tested for effectiveness in reducing radon flux. It is also important to investigate methods of applying various stabilizers to inactive tailings piles in various physical conditions of moisture content, and physical stability. Finally, since the EPA standards for remedial action at tailings piles are stated in terms of radon flux, it is important that radon flux measurements be standardized so that reliable flux measurements can be obtained and directly compared among various laboratories.

10362 (CONF-800334—(Vol.2), pp 386-396) **Site characterization studies in the NWTS program.** Shipler, D. (Battelle Memorial Inst., Columbus, OH); Evans, G. Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The US Department of Energy (DOE) has the responsibility to identify sites and construct and operate facilities for the storage or isolation of spent fuel and/or reprocessing radioactive wastes from commercial nuclear power plants. The National Waste Terminal Storage (NWTS) Program has been initiated by the DOE to develop the technology and demonstrate the feasibility of burial and isolation of high level radioactive waste in deep geologic formations. The NTWS Program plan which sets forth the criteria, procedures, and other considerations required to characterize and select a site in a comprehensive stepwise manner is discussed. The plan is not specific to any given geologic medium but serves as a guide for site selection in any geohydrologic system deemed appropriate for consideration for a deep geologic repository. The plan will be used by all NWTS Project Offices in the conduct of their site characterization program. The plan will be updated, as warranted, to reflect technology development, National policies, rulemakings by regulatory agencies, and other changing political, social, and institutional considerations. Site characterization begins with the identification of regions believed to have suitable geologic, hydrologic, and environmental characteristics for repository siting. This is followed by an iterative process of data collection and analysis to identify areas and locations which appear most suitable for further investigations. In addition, screening studies of the DOE's nuclear complexes has led to the selection of the Nevada Test Site and the Hanford Site for further characterization studies. The site characterization process results in a number of candidate sites from which a site will be selected and proposed to the NRC for licensing.

10363 **(CONF-801107—60) Low-level waste management.** Levin, G.B. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 39p. NTIS, PC A03/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

An overview of the current situation in the United States and a look to the future of low-level waste management are presented. Current problems and challenges are discussed, such as: the need of additional disposal sites in the future; risks and costs involved in transport of low-level wastes; reduction of low-level waste volume through smelting, incineration, and storage for wastes containing nuclides with short half lives; development of a national policy for the management of low-level waste, and its implementation through a sensible system of regulations. Establishing a success with low-level waste management should provide the momentum and public confidence needed to continue on and to resolve the technical and politically more difficult low-level waste problems.

10364 **(DOE/ET/41900—2) Physical and chemical characteristics of candidate wastes for tailored ceramics.** Mitchell, M.E. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 15 Dec 1980. Contract AC09-79ET41900. 30p. (ESG-DOE—13330). NTIS, PC A03/MF A01.

Tailored Ceramics offer a potential alternative to glass as an immobilization form for nuclear waste disposal. The form is applicable to the wide variety of existing wastes and may be tailored to suit the diverse environments being considered as disposal sites. Consideration of any waste product form, however, require extensive knowledge of the waste to be incorporated. A varity of waste types are under consideration for incorporation into a Tailored Ceramic form. This report integrates and summarizes chemical and physical characteristics of the candidate wastes. Included here are data on Savannah River Purex Process waste; Hanford bismuth phosphate, uranium recovery, redox, Purex, evaporator and residual liquid wastes; Idaho Falls calcine; Nuclear Fuel Services Purex and Thorex wastes and miscellaneous waste including estimated waste stream compositions produced by possible future commercial fuel reprocessing.

10365 **(DPSP-AFR—80-6-3) State, federal, nuclear interface: projected AFR needs to year 2000. Executive conference.** King, F.D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1981. Contract AC09-76SR00001. 9p. (CONF-810208—1). NTIS, PC A02/MF A01.

From Executive conference - state, federal nuclear interface; Monterey, CA, USA (2 Feb 1981).

This paper discusses the requirements for additional storage based on various assumptions concerning the plans of nuclear utilities for fuel storage. The data used for the storage projections are being used by the Department of Energy in planning fuel storage, waste disposal operations, and facility requirements; they are also used in evaluating the environmental impacts of waste operations, in calculating the need for waste transport systems, and to set fees to be charged for spent fuel storage and disposal. The most prob-

able demand for AFR storage of spent fuel from domestic reactors in the near term (before 1990) is projected to be approximately 1800 MT. This value is expected to increase rapidly to a total of over 16,000 MT by the year 2000. It is improbable that AFR storage requirements will exceed 22,000 MT by the year 2000 or (assuming reprocessing does not occur) that they will be less than 14,000 MT. Most of the AFR demand will occur after 1985, but a few reactors will operate without sufficient storage space to effect a full core discharge before then. Currently five reactors are without such space, but plans are for them to regain it. These AFR storage projections are significantly lower than prior projections. The decrease in near term storage demands is mainly due to the utilities planning or implementing intrasite fuel movements (onsite transfers) or intra-utility shipments (transshipments) and pool capacity expansions. The longer term decreases in spent fuel storage needs result from delays in the startup of committed reactors and the planned use of longer reactor fuel cycles (increased fuel exposure). The decreased demand for AFR storage is compatible with the previously announced delays in providing government AFR facilities and decreases the projected number of reactors that might be forced to operate without capacity for a full core discharge.

10366 **(EGG-PHS—5312) Photon interrogation annual report for FY-1980.** Nieschmidt, E.B.; Tsang, F.Y.; Lawrence, R.S.; Vegors, S.H. Jr. (EG and G Idaho, Inc., Idaho Falls (USA)). Dec 1980. Contract AC07-76ID01570. 67p. NTIS, PC A04/MF A01.

The Photon Interrogation Technique is being developed for the assay of transuranic materials. A description of source and detector geometry, die-away times and photon flux measurements is given. Considerable effort during FY-1980 was devoted to collimator construction and shielding materials and configurations. Boric acid was found to be a very efficient shielding material for this application. Descriptions and results of these efforts are presented. Results of photon flux determinations, system response to source position and their effects on accuracy are discussed. Changes in the detector system produced a considerable efficiency increase and instrumentation changes brought improved performance. The instrument system with additions can obtain neutron spectral information. A schedule for further development of the system is presented.

10367 **(ENICO—1024) Shield integrity examinations at the NWCF.** Olson, N.C.; Henry, R.N. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Feb 1981. Contract AC07-791D01675. 77p. NTIS, PC A05/MF A01.

A New Waste Calcining Facility has been built at the Idaho Chemical Processing Plant to convert radioactive liquid wastes to the solid form. An extensive examination program of the facility's radiation shielding was performed prior to hot operation. The various techniques used to complete this program are discussed. The results of the program are also described, as well as recommendations on shield examinations.

10368 **(ENICO—1077) Pilot-plant testing of materials proposed for use as NWCF feed and fuel nozzle caps.** Birrer, S.A. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Dec 1980. Contract AC07-79ID01675. 35p. NTIS, PC A03/MF A01.

Results of a series of tests performed on materials proposed for use at New Waste Calcining Facility (NWCF) fuel and feed nozzle caps are described. Results show that Haynes Alloys 25 and 188 and Inconel Alloys 617, 625, and 690 have acceptable corrosion and erosion rates based upon the high-temperature oxidation, erosion, and corrosion tests conducted.

10369 **(IAEA-SM—246/44) Waste immobilization process development at Rocky Flats Plant.** Ziegler, D.L.; Johnson, A.J.; Ledford, J.A. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1980. Contract AC04-76DP03533. 13p. (CONF-800611—10). NTIS, PC A02/MF A01.

From International symposium on the management of alpha-contaminated wastes; Vienna, Austria (2 Jun 1980).

A study was completed identifying the composition and quantities of TRU waste streams generated at a nuclear facility and selecting feasible immobilization methods. Data collected indicated vitrification would be a good match with the waste stream components and that, by combining waste streams, amounts of additives necessary could be minimized. The vitrification process devised consists of blending incinerator ash, calcined sludges, and other granular solid waste with boric oxide and soda ash to produce a mixture containing over 70% waste. This feed composition produces a molten glass at an operating temperature of 1050°C in a reactor constructed of Inconel-690. The product is formed by allowing the molten material to drip onto a rotating plate where it free forms into small pellets. The small amount of gas generated from decomposition of sodium carbonate and residual carbon in the ash, along with sublimated material, is passed through a dry off-gas cleaning system and removed particulate recycled to the reactor. Equipment used to assemble the bench-scale process now operating was designed to reduce mechanical complexity and provide trouble-free operation. The product, small 0.8 g borosilicate glass pellets, can be easily sampled for quality control tests. A number of such tests to measure chemical resistance and mechanical durability have been used. The waste glass pellets have a leach rate, measured by Soxhlet extraction, only an order of magnitude greater than standardborosilicate glass. Mechanical durability is shown by the pellets ability to withstand the impact of a 1.4 kg weight falling one meter, a standard transportation test. Results on these and other tests show the product would meet proposed shipping and permanent repository criteria.

10370 **(MLM—2797(OP)) Use of urethane foam in preparing for decontamination and decommissioning of radioactive facilities.** (Mound Facility, Miamisburg, OH (USA)). 1981. Contract AC04-76DP00053. 5p. (CONF-810112—1). NTIS, PC A02/MF A01.

From Urethane foam expo-6 conference; Orlando, FL, USA (Jan 1981).

Portable urethane foam generating equipment has been in use for 15 to 20 years for a large number of applications, such as roof systems, tank insulation, and building insulation. Still another industrial application is its use in the decontamination and decommissioning of radioactive facilities at Mound Facility. The major problems encountered with urethane foams were with the packaging and stabilization procedures. The operation for spraying the foam on interior surfaces and equipment involved getting the gun inside without opening up the interior to the outside environment A Gusmer FF proportioner and Model D spray gun was used for this operation. The gun was modified so that the trigger could be remotely located to facilitate its entry through a glovebox gloveport opening. The Model D gun has an air cap to blow foam off the tip of the gun. This cap was used to hold a plastic bag in place around the gun. The plastic bag is then put on a glove port and fastened securely. Urethane spray is applied on all exposed surfaces. This assures that all residual material is fixed for shipment. This simplifies cleaning operations as there is no need to remove the last trace of plutonium and results in a considerable shortening of the time required to prepare the gloveboxes. With the interior foamed, the gloveboxes are moved to the loading and packaging areas. Urethane foams are used to fill in the voids in our final shipping container. Radioactive waste materials are segregated according to the level of radioactive material present. One category is low level or low specific activity (LSA) and the other high level or Transuranic (TRU). Foam is used in TRU packages as packaging material to stabilize the loads and to help cushion against shock in transit on truck or railcar.

10371 **(NVO—185(Rev.2)) Operational radioactive waste management plan for the Nevada Test Site.** (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA); Department of Energy, Las Vegas, NV (USA). Nevada Operations Office). Nov 1980. Contract AC08-76NU00410. 84p. NTIS, PC A05/MF A01.

The Operational Radioactive Waste Management Plan for the Nevada Test Site establishes procedures and methods for the safe shipping, receiving, processing, disposal, and storage of radioactive waste. Included are NTS radioactive waste disposition program guidelines, procedures for radioactive waste management, a description of storage and disposal areas and facilities, and a glossary of specifications and requirements.

10372 **(NVO—196-20) Nevada Nuclear Waste Storage Investigations. Quarterly report, July-September 1980.** (Department of Energy, Las Vegas, NV (USA). Nevada Operations Office). Dec 1980. 54p. NTIS, PC A04/MF A01.

Objectives are to improve the technology of nuclear waste storage and disposal and to determine whether underground rock media at NTS are acceptable for a high-level nuclear waste repository. This document reports on ten tasks: weapons test seismic investigations, geologic and hydrologic investigations, media investigations, engineering and technical support, quality assurance, technical overview, Climax spent fuel test, National Waste Terminal Storage program support, rock mechanics investigations, and radionuclide migration investigations. (DLC)

10373 **(ORNL/Sub—79/13837/5) Assessment of alternatives for management of ORNL retrievable transuranic waste. Nuclear Waste Program: transuranic waste (Activity No. AR 05 15 15 0; ONL-WT04).** (Gilbert/Commonwealth, Reading, PA (USA)). Oct 1980. Contract W-7405-ENG-26. 267p. NTIS, PC A12/MF A01.

Since 1970, solid waste with TRU or U-233 contamination in excess of 10 μCi per kilogram of waste has been stored in a retrievable fashion at ORNL, such as in ss drums, concrete casks, and ss-lined wells. This report describes the results of a study performed to identify and evaluate alternatives for management of this waste and of the additional waste projected to be stored through 1995. The study was limited to consideration of the following basic strategies: Strategy 1: Leave waste in place as is; Strategy 2: Improve waste confinement; and Strategy 3: Retrieve waste and process for shipment to a Federal repository. Seven alternatives were identified and evaluated, one each for Strategies 1 and 2 and five for Strategy 3. Each alternative was evaluated from the standpoint of technical feasibility, cost, radiological risk and impact, regulatory factors and nonradiological environmental impact.

10374 **(ORNL/TM—7488) SORA: computer storage or retrieval of radionuclide analyses data.** Huff, D.D. (Oak Ridge National Lab., TN (USA)). Feb 1981. Contract W-7405-ENG-26. 31p. NTIS, PC A03/MF A01.

The need for information on the fate and transport of radionuclides placed in shallow-land disposal sites emphasizes the necessity for an orderly, objective means for storing and retrieving results of radiochemical analyses of samples collected on or near such locations. A computer program (SORA) was developed to aid in organizing such results and to ensure their availability for computer processing. The program documentation provides a format that specifies how results from radiochemical analyses of environmental samples may be recorded. It is also a guide to the listing of results generated by the program.

10375 **(PNL—3035) Review of high-level waste form properties.** Rusin, J.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1980. Contract AC06-76RL01830. 133p. NTIS, PC A07/MF A01.

This report is a review of waste form options for the immobilization of high-level-liquid wastes from the nuclear fuel cycle. This review covers the status of international research and development on waste forms as of May 1979. Although the emphasis in this report is on waste form properties, process parameters are discussed where they may affect final waste form properties. A summary table is provided listing properties of various nuclear waste form options. It is concluded that proposed waste forms have properties falling within a relatively narrow range. In regard to crystalline versus glass waste forms, the conclusion is that either glass of crystalline materials can be shown to have some advantage when a single property is considered; however, at this date no single waste form offers optimum properties over the entire range of characteristics investigated. A long-term effort has been applied to the development of glass and calcine waste forms. Several additional waste forms have enough promise to warrant continued research and development to bring their state of development up to that of glass and calcine. Synthetic minerals, the multibarrier approach with coated particles in a metal matrix, and high pressure-high temperature ceramics offer potential advantages and need further study. Although this report discusses waste form properties, the total waste management system should be considered in the final selection of a waste form option. Canister design, canister materials, overpacks, engineered barriers, and repository characteristics, as well as the waste form, affect the overall performance of a waste management system. These parameters were not considered in this comparison.

10376 **(PNL—3552) Investigation of foaming during nuclear defense-waste solidification by electric melting.** Blair, H.T.; Lukacs, J.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1980. Contract AC06-76RL01830. 66p. NTIS, PC A04/MF A01.

To determine the cause of foaming, the physical and chemical composition of the glass formers that are added to the waste to produce a borosilicate melt were investigated. It was determined that the glass-forming frit was not the source of the foam-causing gases. Incomplete calcination of the waste, which results in residual hydrates, carbonates and nitrates, and the relatively high carbon and sulfate contents of the waste glass composition were also eliminated as possible sources of the foam. It was finally shown that the oxides of the multivalent ions of manganese and iron that are in the defense waste in high concentrations are the source of the foaming. Nickel oxide is also present in the waste and is suspected of contributing to the foaming. In investigating methods to reduce the foam, the focus was on the chemistry of the materials being processed rather than on the mechanical aspects of the processing equipment to avoid increasing the mechanical complexity of the melter operation. Reducing the waste loading in the host glass from 28 to 14 wt. % produced the most significant reduction in the foam. Of course this did not increase the rate at which waste can be processed. Adding carbonaceous additives or barium metaphosphate to the waste/frit mixture (batch) reduced the foaming somewhat. However, if too much reducing agent was added to the batch, iron-nickel alloys separated from the melt. Likewise, melting the batch in an inert or a reducing atmosphere reduced the foaming but produced a heterogeneous product. Finally, initial attempts to control foaming by adding reducing agents to the liquid waste and then spray-calcining it using an inert atomizing gas were not successful. The possibilities for liquid-waste treatment need to be investigated further.

10377 **(PNL—3559) Initial waste package interaction tests: status report.** Shade, J.W.; Bradley, D.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1980. Contract AC06-76RL01830. 83p. NTIS, PC A05/MF A01.

This report describes the results of some initial investigations of the effects of rock media on the release of simulated fission products from a sngle waste form, PNL reference glass 76-68. All tests assemblies contained a minicanister prepared by pouring molten, U-doped 76-68 glass into a 2-cm-dia stanless steel tube closed at one end. The tubes were cut to 2.5 to 7.5 cm in length to expose a flat glass surface rimmed by the canister wall. A cylindrical, whole rock pellet, cut from one of the rock materials used, was placed on the glass surface then both the canister and rock pellet were packed in the same type of rock media ground to about 75 μm to complete the package. Rock materials used were a quartz monzonite basalt and bedded salt. These packages were run from 4 to 6 weeks in either 125 ml digestion bombs or 850 ml autoclaves capable of direct solution sampling, at either 250 or 150°C. Digestion bomb pressures were the vapor pressure of water, 600 psig at 250°C, and the autoclaves were pressurized at 2000 psig with an argon overpressure. In general, the solution chemistry of these initial package tests suggests that the rock media is the dominant controlling factor and that rock-water interaction may be similar to that observed in some geothermal areas. In no case was uranium observed in solution above 15 ppB. The observed leach rates of U glass not in contact with potential sinks (rock surfaces and alteration products) have been observed to be considerably higher. Thus the use of leach rates and U concentrations observed from binary leach experiments (waste-form water only) to ascertain long-term environmental consequences appear to be quite conservative compared to actual U release in the waste package experiments. Further evaluation, however, of fission product transport behavior and the role of alteration phases as fission product sinks is required.

10378 (PNL-SA—7730) Alternative waste forms for immobilization of transuranic wastes. Rusin, J.M.; Palmer, C.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1979. Contract AC06-76RL01830. 38p. (CONF-791045—9). NTIS, PC A03/MF A01.

From American Ceramic Society conference; New Orleans, LA, USA (14 Oct 1979).

Several alternative waste forms are being considered for the immobilization of consolidated trnsuranic (TRU) wastes. General characteristics and applicability of these waste forms to TRU wastes are reviewed. Specific attention is given to recent experimental results on sintered ceramic TRU waste forms including bulk properties, impact resistance, leachability, and volatility.

10379 (PNL-SA—7917) Vitrification of high level wastes: a review of the computer thermal analyses for storage canisters. Wescott, R.I.; Slate, S.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1979. Contract AC06-76RL01830. 36p. (CONF-790822—17). NTIS, PC A03/MF A01.

From 87. AICHE national meeting; Boston, MA, USA (19 Aug 1979).

CANIST, a two-dimensional (r and Θ) computer program that solves the unsteady-state, heat conduction equation was used to model the thermal behavior of canisters filled with waste glass. CANIST has been found to be a valuable analytical tool for predicting the temperature profile of a waste storage canister as a function of several variables, including the diameter of the canister, the placement of internal fins, the heat generation rate of the waste glass, and the thermophysical properties of the canister and the waste glass. Thus, temperature dependent processes that may affect the integrity of the glass/canister unit, for example cracking, can be investigated using an analytical approach. In the present study, the canister temperature profiles predicted by CANIST were compared to canister temperatures measured during full-scale non-radioactive waste immobilization tests conducted at Pacific Northwest Laboratory. The agreement between experimental and predicted temperatures was good, particularly considering the fact that the thermophysical properties of the waste glass modeled have not yet been accurately determined. Examination of some glass-filled canisters has revealed cracking to have occurred in the glass. However, the comparison between measured and CANIST predicted temperatures suggests that cracking does not significantly influence the heat-transfer process. CANIST was also used to evaluate different ways of reducing the centerline temperature of a canister, and to predict the centerline temperature as a function of the heat generation rate of the waste glass and the type of interim storage, i.e., air or water.

10380 (RFP—3131) Preliminary assessment of nine waste-form products/processes for immobilizing transuranic wastes. Crisler, L.R. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). Sep 1980. Contract AC04-76DP03533. 67p. NTIS, PC A04/MF A01.

Nine waste-form processes for reduction of the present and projected Transuranic (TRU) waste inventory to an immobilized product have been evaluated. Product formulations, selected properties, preparation methods, technology status, problem areas needing resolution and location of current research development being pursued in the United States are discussed for each process. No definitive utility ranking is attempted due to the early stage of product/process development for TRU waste containing products and the uncertainties in the state of current knowledge of TRU waste feed compositional and quantitative makeup. Of the nine waste form products/processes included in this discussion, bitumen and cements (encapsulation agents) demonstrate the degree of flexibility necessary to immobilize the wide composition range present in the TRU waste inventory. A demonstrated process called Slagging Pyrolysis Incineration converts a varied compositional feed (municipal wastes) to a "basalt" like product. This process/product appears to have potential for TRU waste immobilization. The remaining waste forms (borosilicate glass, high-silica glass, glass ceramics, "SYNROC B" and cermets) have potential for immobilizing a smaller fraction of the TRU waste inventory than the above discussed waste forms.

10381 (RFP—3138) Transuranic waste management program waste form development. Bennett, W.S.; Crisler, L.R. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1980. Contract AC04-76DP03533. 13p. NTIS, PC A02/MF A01.

The assessment of the available data indicates that dewatered concretes, synthetic basalts, and borosilicate glass waste forms appear to be viable candidates for immobilization of large fractions of the TRU waste inventory in a geologic repository. Product developments and evaluation work will continue. Future investigations will focus on representative actinide-loaded TRU waste being incorporated into the waste forms. Standardized tests are being developed by the Material Characterization Center (MCC) and will be used to obtain and evaluate comparative release rate data for these waste form materials.

10382 (RFP—3181) Low level waste treatment R and D. Blakeslee, J.J. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1981. Contract AC04-76DP03533. 6p. (CONF-810110—1). NTIS, PC A02/MF A01.

From National low level waste management information meeting; San Diego, CA, USA (6 Jan 1981).

A brief description of Rocky Flats plant waste management missions and how it is affiliated with the Department of Energy is presented. A process under development for destruction of nitrate evaporator salts funded by the Low Level Waste Program is described. Included are brief summaries of manpower and schedule, and a short discussion of the applicability of the process should it prove feasible.

10383 (RHO-ST—37) 216-B-5 reverse well characterization study. Smith, R.M. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Nov 1980. Contract AC06-77RL01030. 132p. NTIS, PC A07/MF A01.

The processing of irradiated nuclear fuels at the Department of Energy's (DOE) Hanford Site produced large volumes of radioactive liquid waste. Some of this waste was disposed to the sediments underlying the Hanford Site by means of disposal facilities called reverse wells. One such facility is the 216-B-5 reverse well. This reverse well was one of the first disposal sites used at Hanford, and was in service from 1945 to 1947. An investigation of the 216-B-5 reverse well was conducted during 1979 and 1980. Wells were drilled around the reverse well and sediment samples were collected and analyzed in order to determine the spatial distribution of radionuclides sorbed on the sediments. These analyses were then used to map distributions of $^{239,240}Pu$, ^{137}Cs, and ^{90}Sr around the reverse well. The impact of the sorbed radionuclides on groundwater contamination was considered.

10384 (SAND—80-1476) Thermally induced motion of marine sediments resulting from disposal of radioactive wastes. Chavez, P.F.; Dawson, P.R. (Sandia National Labs., Albuquerque, NM (USA); Cornell Univ., Ithaca, NY (USA). Sibley School of Mechanical and Aerospace Engineering). Jan 1981. Contract AC04-76DP00789. 57p. NTIS, PC A04/MF A01.

Coupled creep and heat transfer calculations have been performed to assess the sensitivity of heat load, viscosity, and canister density on the motion of waste canisters buried in marine sediments. Results indicate that no upward movement is predicted for heat loads remaining within the metallurgical and geochemical constraints placed on the temperature of sediments near the canister for the times analyzed. Upward movement of the canister is again not observed in calculations involving reasonable variations of the sediment viscosity and canister density. Maximum effective deviatoric stress levels due to thermally induced differential body forces are significantly less than the sediment's short term peak strength.

10385 (SAND—80-2190C) Status of Sandia backfill-getter development studies. Molecke, M.A.; Nowak, E.J. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 8p. (CONF-801209—7). NTIS, PC A02/MF A01.

From 2. annual National Waste Terminal Storage (NWTS) information meeting; Columbus, OH, USA (9 Dec 1980).

In this paper, specific functions desired of the backfill as well as various recent experimental studies, results, and current plans for further studies, and modeling of the backfill's effectiveness for delaying radionuclide release are presented. Experimental studies and results are as follows: smectite swelling clay, bentonite, has been selected as a major component in the backfill because of its favorable properties in contact with salt and brine solution; sorptive properties for Pu and Am in batch and column-type experiments are being measured; various materials such as synthetic zeolites, titanates, and charcoal show promise for sorbing fission products in brine; mechanisms of backfill alte ation or degradation which may cause the backfill barrier to lose some of its chemical and physical effectiveness is being investigated, with pH, Eh, temperature, pressure, radiation, and backfill-getter overall composition as parameters of interest; hydrothermal backfill-brine reactions have been studied experimentally; geotechnical measurements on bentonite and bentonite-sand mixtures have yielded brine and water permeabilities in the microdarcy range; and engineering-scale work on backfill emplacement forms and techniques to be used in a repository is under investigation, and will culminate with an actual demonstration of backfill emplacement in a field test.

10386 **(SAND—80-7119) Interpretation of wireline geophysical logs. ERDA No. 9 stratigraphic test borehole, DOE WIPP Site, Eddy County, New Mexico.** Griswold, G.B.; McWhirter, V.C. (Tecolote Corp., Albuquerque, NM (USA); Dresser Atlas, Houston, TX (USA)). Feb 1981. Contract AC04-76DP00789. 98p. NTIS, PC A05/MF A01.

A stratigraphic core hole known as ERDA No. 9 was drilled at the approximate center of the Waste Isolation Pilot Plant (WIPP) site located east of Carlsbad, New Mexico. The hole was continuously cored from 1090 to 2887 feet, the total depth of the hole. A suite of 20 wireline geophysical logs were made under open hole conditions over the cored interval. Recording in the field was by analog strip charts. The records were subsequently digitized at 0.5 foot intervals with the data placed on magnetic tape. A simple computer program was devised to interpret rock type and calculate elastic properties based on the digital data. All of the data is available in convenient digital form, and additional computer-assisted analysis is now possible to describe the detailed stratigraphy of the evaporites penetrated in ERDA No. 9. The analysis performed thus far is in excellent agreement with physical examination of the core. The main advantage of correlating the wireline geophysical logs with core is to provide a better basis for using wireline logs to describe rock conditions either in future holes drilled by the simpler rotary method or where core has been lost in cored holes.

10387 **(UCRL—53087) Response of borehole extensometers to explosively generated dynamic loads.** Patrick, W.C.; Brough, W.G. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 25 Aug 1980. Contract W-7405-ENG--48. 16p. NTIS, PC A02/MF A01.

Commercially available, hydraulically anchored, multiple-point borehole extensometers (MPBX) were evaluated with respect to response to dynamic loads produced by explosions. This study is part of the DOE-funded Spent Fuel Test-Climax (SFT-C), currently being conducted in the Climax granitic stock at the Nevada Test Site. The SFT-C is an investigation of the feasibility of short-term storage and retrieval of spent nuclear reactor fuel assemblies at a plausible repository depth in granitic rock. Eleven spent fuel assemblies are stored at a depth of 420 m for three to five years, and will then be retrieved. MPBX units are used in the SFT-C to measure both excavation-induced and thermally induced rock displacements. Long-term reliability of extensometers in this hostile environment is essential in order to obtain valid data during the course of this test. Research to date shows conclusively that extensometers of this type continue to function reliably even though subjected to accelerations of 1.8 g; research also implies that they function well though subjected to accelerations in excess of 100 g. MPBX survivability during the first four months of testing at ambient temperatures was about 90 percent.

10388 **Method for encasing waste barrels in a leachproof closed sheath.** Uerpmann, E. (to Gesellschaft Fur Strahlen Und Umweltforschung Mbh (Germany, Federal Republic Of)). US Patent 4,222,889. 16 Sep 1980. vp.

Radioactive wastes are encased in closed sheaths, the wastes to be solidified with binders and accommodated in barrels and the closed sheath to be resistant to water and aqueous solutions of natural mineral salts and to leaching, by completely surrounding the waste by a synthetic resin layer between the waste and the barrel or around the barrel containing the waste in accordance with specific methods involving applying spacing layers in the areas to be occupied by the resin layer and subsequently filling the spacing layer with a synthetic resin and a solvent.

10389 **Treatment of substances.** Gayler, R.; Hardwick, W.H. (to United Kingdom Atomic Energy Auth (United Kingdom)). US Patent 4,221,680. 9 Sep 1980. vp.

A process and apparatus are disclosed for the treatment of a substance contained in a solution or a slurry. The solution or slurry can be treated to give a fusible dried product by use of microwave radiation. The fusible dried product can be heated and fused by use of microwave radiation.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 10385, 10395, 10916, 11028, 11029, 11030, 11031, 11032, 11033

10390 **(AD-B—951743) Operation Buster-Jangle - radiological safety. Report for Oct-Nov 51.** Shipman, T.L. (General Electric Co., Santa Barbara, CA (USA)). 1 Oct 1979. 62p. NTIS, PC A04/MF A01.

A description of the responsibilities, organization, and activities of the Radiological Safety and Health Unit for Operation Buster-Jangle is given. Suggestions as to changes which should improve the operation of, and the service rendered to, the Test Director by such a unit are also included. Data on radiation exposure of operation personnel, decontamination, residual radiation levels of shot sites, residual off-site radiation levels, and off-site fallout intensities are included.

10391 **(CONF-800334—(Vol.2)) Proceedings of the second US Department of Energy environmental control symposium. Volume 2. Nuclear energy, conservation, and solar energy.** (Argonne National Lab., IL (USA)). Jun 1980. Contract W-31-109-ENG-38. 769p. NTIS, PC A99/MF A01.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

These proceedings document the presentations given at the Second Environmental Control Symposium. Symposium presentations highlighted environmental control activities which span the entire DOE. Volume II contains papers relating to: environmental control aspects of nuclear energy use and development; nuclear waste management; renewable energy sources; transportation and building conservation (fuel economy, gasohol, building standards, and industry); and geothermal energy, power transmission, and energy storage. (DMC)

10392 (CONF-800334—(Vol.2), pp 372-385) **Site identification: environmental and radiological considerations.** Waite, D.A. (Battelle Memorial Inst., Columbus, OH). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

Radiological and environmental considerations are recognized as being of utmost importance in planning, siting, licensing, operating, and decommissioning a high-level nuclear waste repository. In such a complex undertaking, it is important to identify the major concerns anticipated to arise in all of these phases in order to address them as early as possible in the program. Three representative activities/studies are summarized which will identify some of the important radiological and environmental considerations which must be addressed through this prolonged sequence of events and will indicate how these considerations are being addressed. It should be emphasized that these are only three of many which could have been chosen. The three key activities/studies are: (1) the NWTS Program criteria for identifying repository sites, (2) the generic guide for preparing environmental evaluations for deep drilling and (3) a preliminary environmental assessment for disposal of mined rock during excavation of a repository.

10393 (CONF-800334—(Vol.2), pp 397-404) **Public comments on the draft generic environmental impact statement for management of commercially generated radioactive waste.** Kreiter, M.R.; Unruh, C.M.; McCallum, R.F. (Pacific Northwest Lab., Richland, WA). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The US Department of Energy has the responsibility for developing the technology required for managing commercial radioactive wastes in an environmentally acceptable manner. As part of this responsibility, DOE has prepared a draft environmental impact statement on the management of commercially generated radioactive waste. The draft was issued for public comment in April of 1979; five public hearings were held. The draft GEIS is intended to provide environmental input for the selection of an appropriate program strategy for the permanent isolation of commercially generated high-level and transuranic wastes. The scope of such a strategy includes research and development into alternative treatment processes and emplacement media, site investigations into candidate media, and the examination of advanced waste management technologies. The draft statement describes the commercial radioactive wastes that would have to be managed for very long periods of time from an assumed nuclear generation scenario of 10,000 GWe-yr of power over a 65-year period ending in 2040.

10394 **(PNL—3302) Relationships of dispersive mass transport and stochastic convective flow through hydrologic systems.** Simmons, C.S. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1981. Contract AC06-76RL01830. 149p. NTIS, PC A07/MF A01.

Uncertainty in water flow velocity appears to be a major factor in determining the magnitude of contaminant dispersion expected in a ground water system. This report discusses some concepts and mathematical methods relating dispersive contaminant transport to stochastic aspects of ground water flow. The theory developed should not be construed as absolutely rigorous mathematics, but is presented with the intention of clarifying the physical concepts.

0540 Health And Safety

10395 (CONF-800334—(Vol.2), pp 90-116) **DOE program for control of radioactivity releases to the environment.** Welty, C.G.; Deal, L.J.; Toussaint, C.R.; Baker, K.R.; Campbell, C.M. Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The DOE program for control of radioactivity releases to the environment utilizes environmental monitoring, impact assessment and overview to assure that radioactivity releases are as low as reasonably achievable. A special effort was initiated in 1970 to improve the management and control of radioactivity releases from DOE installations. As a result, there has been a general downward trend in overall radioactivity releases from DOE installations since that time in spite of an increase in operations at some installations. Assessments of population exposure from all pathways indicate that at all DOE installations, the maximum individual exposure offsite is less than 10% of the 500 mrem annual limit and at most installations is less than 1% of the limit. The 80 km radius population whole body dose commitments in the vicinity of individual DOE installations ranged up to 180 man-rem in 1978 and totaled 505 man-rem for all DOE operations that year.

10396 **(SAND—80-2142) Uranium mill tailings and radon.** Hanchey, L.A. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 30p. NTIS, PC A03/MF A01.

The major health hazard from uranium mill tailings is presumed to be respiratory cancer resulting from the inhalation of radon daughter products. A review of studies on inhalation of radon and its daughters indicates that the hazard from the tailings is extremely small. If the assumptions used in the studies are correct, one or two people per year in the US may develop cancer as a result of radon exhaled from all the Uranium Mill Tailings Remedial Action Program sites. The remedial action should reduce the hazard from the tailings by a factor of about 100.

10397 **(UCID—18886) Safety Analysis (SA) of the decontamination facility, Building 419, at the Lawrence Livermore National Laboratory.** Odell, B.N. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 17 Jun 1980. Contract W-7405-ENG-48. 35p. NTIS, PC A03/MF A01.

This safety analysis was performed for the Manager, Plant Services at LLNL and fulfills the requirements of DOE Order 5481.1. The analysis was based on field inspections, document review, computer calculations, and extensive input from Waste Management personnel. It was concluded that the maximum quantities of radioactive materials that safety procedures allow to be handled in this building do not pose undue risks on- or off-site even in postulated severe accidents. Risk from the various hazards at this facility vary from low to moderate as specified in DOE Order 5481.1. Recommendations are made for improvements that will reduce risks even further.

0550 Regulations

REFER ALSO TO CITATION(S) 11023, 11024, 11025, 11026, 11027, 11028, 11029, 11030, 11031, 11032, 11033, 11302, 11303

10398 **(DOE/S—0010R1) Second annual report on nuclear non-proliferation: supplement to Secretary's Annual Report to Congress.** (Department of Energy, Washington, DC (USA)). 1980. 16p. NTIS, PC A02/MF A01.

This document covers: goals of US nonproliferation policy, agreements for cooperation, technical exchange, US as a reliable supplier of nuclear fuels, IAEA Expert Group on International Plutonium Storage, implementation of US nonproliferation policy, classification, cooperation in strengthening international safeguards and physical security, the US-IAEA voluntary offer safeguards agreement, US spent fuel storage policy, development of proliferation-resistant fuel cycle technologies, and the International Nuclear Fuel Cycle Evaluation. (DLC)

10399 **(LA—8620-C(Vol.1)) International training course on nuclear materials accountability for safeguards purposes.** (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 501p. (CONF-8005137—(Vol.1)). NTIS, PC A22/MF A01.

From International training course on nuclear materials accountability for safeguards purposes; Santa Fe, NM, USA (27 May 1980).

The two volumes of this report incorporate all lectures and presentations at the International Training Course on Nuclear Materials Accountability and Control for Safeguards Purposes, held May 27-June 6, 1980, at the Bishop's Lodge near Santa Fe, New Mexico. The course, authorized by the US Nuclear Non-Proliferation Act and sponsored by the US Department of Energy in cooperation with the International Atomic Energy Agency, was developed to provide practical training in the design, implementation, and operation of a National system of nuclear materials accountability and control that satisfies both National and IAEA International safeguards objectives. Volume I, covering the first week of the course, presents the background, requirements, and general features of material accounting and control in modern safeguard systems. Volume II, covering the second week of the course, provides more detailed information on measurement methods and instruments, practical experience at power reactor and research reactor facilities, and examples of operating state systems of accountability and control.

10400 **(LA—8620-C(Vol.2)) International training course on nuclear materials accountability for safeguards purposes.** (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 497p. (CONF-8005137—(Vol.2)). NTIS, PC A21/MF A01.

From International training course on nuclear materials accountability for safeguards purposes; Santa Fe, NM, USA (27 May 1980).

The two volumes of this report incorporate all lectures and presentations at the International Training Course on Nuclear Materials Accountability and Control for Safeguards Purposes, held May 27-June 6, 1980, at the Bishop's Lodge near Santa Fe, New

Mexico. The course, authorized by the US Nuclear Non-Proliferation Act and sponsored by the US Department of Energy in cooperation with the International Atomic Energy Agency, was developed to provide practical training in the design, implementation, and operation of a National system of nuclear materials accountability and control that satisfies both National and IAEA International safeguards objectives. Volume I, covering the first week of the course, presents the background, requirements, and general features of material accounting and control in modern safeguard systems. Volume II, covering the second week of the course, provides more detailed information on measurement methods and instruments, practical experience at power reactor and research reactor facilities, and examples of operating state systems of accountability and control.

10401 **(LA—8663-MS) Safeguards in the seventies. A bibliography of LASL safeguards R & D publications, 1970-1979.** Klein, S.L. (comp.). (Los Alamos Scientific Lab., NM (USA)). Jan 1981. Contract W-7405-ENG-36. 70p. NTIS, PC A04/MF A01.

This bibliography is a compilation of technical reports and publications generated by the Los Alamos Scientific Laboratory's Nuclear Safeguards R & D Program from 1970 to 1979.

10402 **(SAND—80-1746) Improved self-energized credential system.** Caffey, T.W.H.; Pregent, W.D. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 59p. NTIS, PC A04/MF A01.

An improved portal and associated electronics that operate with any orientation of the credential at rates in excess of 11,000 credentials per hour are described. Electronic schematics are discussed in detail, and ordering instructions for the fabrication drawing set are included. The external electromagnetic fields are less than the FCC criteria for a low-power, unlicensed transmitter.

06 FUSION FUELS

0602 Processing

10403 **Apparatus for forming targets.** Woerner, R.L. (to Department of Energy). US Patent 4,221,186. 9 Sep 1980. Filed date 24 Jan 1979. vp.

PAT-APPL-924,335.

Apparatus and method for cryoinduced uniform deposition of cryogenic materials, such as deuterium-tritium (Dt) mixtures, on the inner surface of hollow spherical members, such as inertially imploded targets. By vaporizing and quickly refreezing cryogenic materials contained within a hollow spherical member, a uniform layer of the materials is formed on the inner surface of the spherical member. Heating of the cryogenic material, located within a non-isothermal compact freezing cell, is accomplished by an electrical heat pulse, whereafter the material is quickly frozen forming a uniform layer on the inner surface of the spherical member. The method is not restricted to producing a frozen layer on only the inner surface of the innermost hollow member, but where multiple concentric hollow spheres are involved , such as in multiple shell targets for lasers, electron beams, etc., layers of cryogenic material may also be formed on the inner surface of intermediate or outer spherical members, thus providing the capability of forming targets having multiple concentric layers or shells of frozen dt.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

10404 **Method for separating isotopes in the liquid phase at cryogenic temperature.** Brueck, S. R.; Osgood, R. M. (to Massachusetts Institute Of Technology). US Patent 4,220,510. 2 Sep 1980. Filed date 13 Jul 1978. vp.

Isotopes are separated from an isotopically mixed molecular dopant dissolved in a cryogenic liquid. The solution is exposed to infrared laser light in order to selectively vibrationally excite a particular molecular species which contains the isotope or isotopes that are to be separated. The excited species then is reacted or dissociated to form recoverable reaction products rich in the isotope desired.

0702 Radiation Sources

10405 **(PNL—1845-48) Quarterly report on the strontium heat source development program, advanced nuclear systems and projects division for June-September 1980.** Fullam, H.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1981. Contract AC06-76RL01830. 22p. NTIS, PC A02/MF A01.

Hastelloy S and Hastelloy C-4 subsize Charpy V-Notch (CVN) specimens that had been heated in air or vacuum at 600°, 700°, or 800°C for up to 10,000 h were impact-tested at room temperature. No significant differences in Charpy impact energy were observed between the CVN specimens heated in air and the control specimens heated in vacuum. The CVN specimens aged at 600°C showed the greatest reduction in Charpy impact energy, while the specimens aged at 800°C showed the least change. Qualification testing of the as-fabricated prototype outer capsules was completed. The capsules passed all of the qualification tests without difficulty. The capsules subjected to the impact (drop) test showed some distortion at the weld area but passed the helium leak test. After the qualification tests were completed two of the capsules were subjected to additional external-pressure tests. The Hastelloy S capsule was pressurized to 24,000 psi (the limit of the autoclave) and showed only a slight distortion. The Hastelloy C-4 capsule collapsed at a pressure of 20,750 psi. Both capsules passed the helium leak check after pressurization. Two other capsules were subjected to an increased percussion test using an impact energy of 20 kg-m instead of the 7 kg-m used in the standard test. Both the Hastelloy S and Hastelloy C-4 capsules passed the more stringent test without difficulty.

0703 Isotopic Power Supplies

10406 **(DPST—79-128-11/12) ^{238}Pu fuel form processes. Bimonthly report, November-December 1979.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Nov 1980. Contract AC09-76SR00001. 32p. NTIS, PC A03/MF A01.

Progress in the Savannah River Laboratory's ^{238}Pu Fuel Form Program is summarized. Full-scale fabrication tests continued in the Plutonium Experimental Facility (PEF) with the successful fabrication of seven additional GPHS pellets. Three pellets (GPHS Pellets 14, 15, and 16) were fabricated at off-centerline conditions to help define process limits for production of GPHS fuel pellets in the Plutonium Fuel Fabrication (PuFF) Facility. Two additional limit-test pellets (GPHS Pellets 12 and 13) previously hot pressed underwent final heat treatment. Two pellets (GPHS Pellets 17 and 18) were fabricated at centerline conditions as part of the effort to have Savannah River Laboratory (SRL) GPHS pellets impact tested at LASL. All seven pellets remained integral and demonstrated excellent dimensional stability during final heat treatment. However, the quality of those pellets fabricated at centerline conditions was superior to those that were fabricated as part of the limit tests.

10407 **(PNL—3641) Effects of oxidation on the impact energy of Hastelloy S and Hastelloy C-4 Charpy V-notch specimens heated in air at 600° to 800°C.** Fullam, H.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1981. Contract AC06-76RL01830. 37p. NTIS, PC A03/MF A01.

The $^{90}SrF_2$ heat source being developed at PNL utilizes a Hastelloy S or Hastelloy C-4 outer capsule having a 0.5-in.-thick wall to contain the Hastelloy C-276 inner capsule. The primary objective of the study was to demonstrate that the air oxidation of the outer capsule that could occur during heat-source service would not degrade the ductility and Charpy impact strength of the capsule below the licensing requirements given in Section 1.1. The $^{90}SrF_2$ heat source under development is intended for general-purpose use. Compatibility considerations limit the interface temperature be-

tween the $^{90}SrF_2$ and Hastelloy C-276 inner capsule to a maximum of 800°C. The outer capsule surface temperature will be somewhat less than 800°C, and depending on the service, may be substantially lower. The oxidation tests were therefore carried out at 600° to 800°C for exposures up to 10,000h to cover the range of temperature the outer capsule might expect to encounter in service. The results showed that the oxidation of Hastelloy S and Hastelloy C-4 in air at 600° to 800°C is very slow, and both alloys form adherent oxide layers that serve to protect the underlying metal. Subsurface attack of Hastelloy S and Hastelloy C-4 due to oxidation was greater than expected, considering the slow oxidation rates of the two alloys at 600° to 800°C. Estimates of subsurface attack, determined from micrographs of the oxidized specimens, showed erratic results and it was impossible to assign any type of rate equation to the subsurface attack. A conservative estimate of long-term effects can be made using a linear extrapolation of the test results. There were no significant differences between the room-temperature Charpy impact energy of Hastelloy S and Hastelloy C-4 specimens oxidized in air at 600° to 800°C and control specimens heated in vacuum.

10408 **(DOE/SF/01123—T14(Vol.1)(Bk.2)) Brayton Isotope Power System: Phase II plan. Garrett program plan.** (AiResearch Mfg. Co., Phoenix, AZ (USA)). 15 Mar 1978. Contract AC03-76SF01123. 210p. NTIS, PC A10/MF A01.

The Phase II program plan for developing the Brayton Isotope Power System for space vehicles is presented in detail with information on task descriptions, schedules, program organization, personnel, and program options. (LCL)

08 HYDROGEN

10409 **DOE program on hydrogen energy systems.** Berger, B.J.; Swisher, J.H. (US DOE, Washington, DC). *ACS (American Chemical Society) Symposium Series ;* No. 116, 27-31(1979). (CONF-790415—).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

This paper briefly describes the research program of the Department of Energy on various factors affecting the production, storage, transportation and utilization of hydrogen. The discussion covers the following subjects--DOE hydrogen budget; basic research; and applied research on hydrogen.

0801 Production

REFER ALSO TO CITATION(S) 10154

10410 **(AD-A—087053) Process evaluation - steam reforming of diesel fuel oil. Final technical report 24 Apr-24 Dec 79 on phases 1-4.** Jarvi, G.A.; Bowman, R.M.; Camara, E.H.; Lee, A.L. (Institute of Gas Technology, Chicago, IL (USA)). 15 Feb 1980. 52p. NTIS, PC A04/MF A01.

This project is an evaluation of a proprietary catalyst as a means of steam-reforming diesel fuel oil (Fed. Spec. VV-F-800B, symbol DF-2). A system for testing the catalyst has been designed, built and successfully used to screen operating conditions of temperature, space velocity, and H2O/C ratio. A duration test has been conducted showing the catalyst capable of steam reforming diesel fuel, but with the production of naphthalene after 30 hours. Hydrogen production remained stable through the 86 hours of the test.

10411 **(AD-A—087364) Photocatalytic production of hydrogen from water and texas lignite using a platinized titania catalyst. Technical report No. 16, 1 Jan-31 Dec 80.** Sato, S.; White, J.M. (Texas Univ., Austin (USA). Dept. of Chemistry). 15 Jul 1980. 11p. NTIS, MF A01.

Using a physical mixture of powdered Texas lignite and platinized titania in the presence of water vapor and ultraviolet light, we show that a catalytic reaction occurs at 23 C to form hydrogen and carbon dioxide. These results are contrasted with a recent electrochemical conversion process.

10412 **Production of hydrogen from carbon monoxide and water.** Anderson, L.R.; Novotny, M. (to Allied Chemical Corp). US Patent 4,223,001. 16 Sep 1980. Filed date 20 Jun 1978. vp.

An improved process is described for producing hydrogen from carbon monoxide and water in which carbon monoxide is contacted under homogeneous conditions with an alkaline aqueous liquid phase containing a soluble rhodium-containing catalyst at a reaction temperature from about 100 to 300°C and at a reaction pressure from about 1 to 300 atmospheres in the presence of a saturated paraffinic water-soluble alcohol.

10413 **Process for reforming hydrocarbon fuel into hydrogen-rich fuel.** Kosaka, K.; Nagaoka, T.; Ueno, Z. (to Nissan Motor Co Ltd (Japan)). US Patent 4,222,351. 16 Sep 1980. Filed date 18 Mar 1977. vp.

In the preparation of a gaseous fuel mixture mainly of hydrogen, carbon monoxide and carbon dioxide from a hydrocarbon fuel in the presence of oxygen and water by either the partial combustion process or the catalytic decomposition, the product of catalytic decomposition of an aqueous solution of hydrogen peroxide is utilized as the oxygen and water sources. When a relatively dilute hydrogen peroxide solution is used, the resulting liquid phase water may be separated from the decomposition product and introduced into either the subsequent reaction system or the produced fuel mixture.

0802 Storage

10414 **Hydrogen technology--an overview.** Salzano, F.J.; Mezzina, A.; Beller, M.; Strickland, G.; Srinivasan, S. (Brookhaven Natl Lab, Upton, NY). *ACS (American Chemical Society) Symposium Series ;* No. 116, 33-44(1980). (CONF-790415—).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

This paper provides an overview of hydrogen technology and identifies the needs for further development, in order that hydrogen achieves its ultimate potential. The subject is discussed under headings--transmission; large bulk storage; small scale storage; hydrogen energy system and fuel cell (utility-stationary applications, industrial-residential-commercial-total energy system, automotive-mobile applications, economics); international cooperation on hydrogen programs; RandD incentives and requirements.

0806 Industrial And Commercial Use

10415 **Hydrogen in oil refinery operations.** Corneil, H.G.; Heinzelmann, F.J. (Exxon Enterp Inc, Florham Park, NJ). *ACS (American Chemical Society) Symposium Series ;* No. 116, 67-94(1980). (CONF-790415—).

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

Hydrogen, a key processing agent in petroleum-refining operations, is consumed in a variety of hydrodesulfurization and hydrocracking operations. Some of the required hydrogen is produced as a by-product of naphtha reforming conducted for octane improvement. The greater portion of the required hydrogen is produced by steam reforming of natural gas (or some alternative light hydrocarbon), although partial oxidation of residuum is used to a limited extent. Estimates from this study indicate that steam reforming of natural gas or light naphtha will continue to be more attractive than coal gasification for producing refinery hydrogen.

09 OTHER SYNTHETIC AND NATURAL FUELS

REFER ALSO TO CITATION(S) 11091, 11263

10416 **(AD-A—087418) Alternative fuels for maritime use. Committee report.** (National Research Council, Washington, DC (USA). Maritime Transportation Research Board). May 1980. 204p. Availability: Office of Publications, National Academy of Sciences, 2101 Constitution Avenue, N.W. Washington, DC 20418 HC $9.75 (No copies furnished by DTIC).

The objectives of this study were to review the potential fuels that may be available to the marine industry from 1980 to 2000 and to define the economic, technical, environmental, and social impacts of these alternative fuels on marine power plants. From the outset of this study the committee agreed that three basic questions face the maritime industry concerning alternative fuels: (1) What are the likely alternative fuels that may be used by the maritime industry (2) What has to be done to use these fuels. (3) How will these fuels perform in various types of prime movers. Many groups are currently engaged in similar studies, and in reaching our conclusions we have tried to make maximum use of the information available. We hope this report will assist the industry in making decisions about which power plants to use in new construction and which alternate fuels may be used in current vessels.

10417 **Nonpetroleum vehicular fuels: symposium papers.** Chicago, IL; Institute of Gas Technology (1980). 377p. (CONF-800263—). $40.00.

From Symposium on nonpetroleum vehicular fuels; Arlington, VA, USA (11 Feb 1980).

A three day symposium on Nonpetroleum Vehicular Fuels was held in Arlington, Virginia, February 11 to 13, 1980. The central theme of the conference was the exchange of information on the successful use of nonpetroleum vehicular fuels and the identification of problems which might hinder the acceptance of these alternative fuels. Presentations and discussions included: current domestic and foreign activities to develop nonconventional vehicular energy; research and development efforts to provide new engines, vehicles and on-board hardware for economical, safe, and environmentally acceptable operation; programs to produce, market, and utilize such fuels; institutional constraints such as tax laws, environmental and safety regulations which may slow acceptance; programs needed to speed growth of the nongasoline alternative and increase customer acceptance; and commercial applications. In attendance were experts on fuels, engines, electric vehicles, energy delivery systems, government regulations, and environmental regulations. The papers presented are reproduced in full in this volume. Separate abstracts have been prepared for individual papers for inclusion in the Energy Data Base.

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 10477, 10515, 10645, 11314

10418 (CONF-800334—(Vol.2), pp 262-282) **Characterization and treatment of anaerobically digested cattle manure.** Austin, T.A.; Dahab, M.F. (Iowa State Univ., Ames). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The limited survey of some of the cattle waste digesters in operation in the US indicates that the effluent from these digesters could result in some pollutional problems unless adequate disposal methods are put into effect. Although any pollutional problems that may occur are expected to be localized in the immediate area of disposal, severe surface and ground water contamination may take place. Despite its relative efficiency in removing considerable amounts of BOD_5 and COD from digester effluents, aerobic treatment is undoubtedly a costly alternative compared to land application. Land application, however, must be managed so that repeated application would not result in stream and ground water contamination.

10419 **(DOE/ER/10113—8) Fundamental combustion studies of emulsified fuels. Annual progress report, October 1, 1979-September 30, 1980.** Kennedy, I.M. (Princeton Univ., NJ (USA). Dept. of Mechanical and Aerospace Engineering). 1980. Contract AS02-78ER10113. 17p. NTIS, PC A02/MF A01.

A research program in the Fuels Research Laboratory at Princeton University has provided fundamental information on the combustion properties of emulsions and multi-component fuel mixtures. Particular attention has been given to understanding the phenomenon of micro-explosions and disruptive combustion. Earlier work which investigated the behavior of n-paraffin and water emulsions, binary mixtures of n-paraffins, and solutions of alcohol with n-paraffins has been completed and is now published in the open literature. This work has been extended during the current contract period to the study of the droplet combustion of a No. 2 fuel oil. Both emulsions with water and solutions of alcohols were investigated and very useful data were generated with regard to the optimization of the disruption phenomenon in terms of additive content. In addition, some preliminary work has been done with microemulsions. This indicated the importance of further work to elucidate the role of surfactant loading. Theoretical work on the growth of gaseous bubbles in fuel droplets has helped to define some of the controlling parameters in the disruption phenomenon. Finally the design of a new free droplet apparatus has been completed and a novel optical diagnostic technique for droplet sizing is near completion. This program has generated information which is of general interest in the field of droplet combustion and represents a considerable advance in our understanding of fuel related combustion phenomena.

10420 **(DOE/PC/30220—T1) Catalytic combustion of synthetic fuels. Semi annual report, August 1, 1980-January 31, 1981.** Kennedy, L.A.; Ruckenstein, E. (State Univ. of New York, Buffalo (USA). School of Engineering and Applied Science). 1981. Contract FG22-80PC30220. 6p. NTIS, PC A02/MF A01.

During the period August 1, 1980 to January 31, 1981, the efforts on this project were directed towards three goals: (1) catalyst development; (2) preliminary measurements of fuel bound nitrogen conversion; and (3) design of a droplet injector and vaporization section for use with SRC-II liquids. The effect of inlet conditions and bed length on combustion efficiency will be studied. Of particular interest is the sensitivity of the system to small perturbations and the hysteresis phenomena indicated in some preliminary experiments. An experimental apparatus has been designed to examine NO conversion in a catalytic combustor. Argon-oxygen is the oxidizing gas. Minimizing conversion of fuel nitrogen to nitrogen oxides is the aim of this task. Propane doped with nitrogen compounds will be tested in our catalytic combustor. Detailed measurements of a complete nitrogen balance will be made for different inlet conditions, residence times and levels of fuel nitrogen compounds. Work has been started designing a multiport injector for coal derived liquid fuels. It is expected to be completed by May-June 1981 and installed in our combustor by mid-summer.

10421 **(DOE/PC/30298—T1) Soot formation in synthetic-fuel droplets. First quarterly technical progress report.** England, G.; Kramlich, J.; Payne, R. (Energy and Environmental Research Corp., Santa Ana, CA (USA)). Jan 1981. Contract AC22-80PC30298. 14p. NTIS, PC A02/MF A01.

The objective of this project is to provide detailed information on methods of minimizing soot formation during synthetic liquid fuel combustion under conditions which minimize fuel nitrogen conversion to nitric oxide. The program consists of two tasks. The purpose of the first task, Fuel Screening Studies, is to investigate the impact of fuel properties on particulate production, to establish the importance of droplet size and examine atomizer effects, and to develop techniques for surrogate fuels productions. In the second task, Flame Studies, the fundamental details of soot formation from synfuel droplet combustion will be investigated in variable slip velocity configurations. This present report describes technical progress during the first three months of the program effort (October-December 1980). During this initial period, attention has focused on the definition of the different experimental efforts and on the design and construction of the required hardware. Aspects of this work are discussed.

10422 (EMD—77-1420) Methane production from carbon oxides over borohydride reduced transition metals. II. Final report. Russell, T.W. (Eastern New Mexico Univ., Portales (USA). School of Natural Science). Nov 1980. 27p. University of New Mexico, New Mexico Energy Inst., Albuquerque.

This study was undertaken to continue the examination of the utility of borohydride-reduced transition metals as catalysts for the hydrogenation of carbon oxides to produce synthetic fuels. While most related efforts deal only with carbon monoxide (the predominant oxide in coal gasification processes), we have included carbon dioxide in our work. Work with copper, cobalt, nickel and palladium has resulted in methane production from both carbon oxides, with carbon dioxide being only slightly less productive than carbon monoxide. From the last three metals, methane is the only carbon-containing product formed. This is a definite improvement over many of the catalysts reported in the scientific literature, where a major problem is the production of numerous carbon-containing products, thereby necessitating means of separation of the various products. Discovery that copper, prepared from sodium borohydride reduction of cupric salts, produces both methane and methyl alcohol is without comparison in the literature. Detailed studies on copper are continuing. Continuous methanation over borohydride-reduced nickel has shown no decrease in methane production of 90 to 93% during a 1000+ hour run.

10423 (PB—80-811375) Synthetic fuels from municipal, industrial, and agricultural wastes. 1964-June, 1980 (citations from the NTIS data base). Report for 1964-Jun 80. Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 230p. NTIS PC N01/MF N01.

Research efforts directed toward production of gaseous and liquid synthetic fuels from solid wastes are discussed. Waste products used in the syntheses include manure, sewage, paper, and wood. In most citations, methane is the primary fuel produced; however, the production of oils, methanol, and ethanol is also discussed. (This updated bibliography contains 218 abstracts, 54 of which are new entries to the previous edition.)

10424 Dependence of soot production on fuel blend characteristics and combustion conditions. Blazowski, W.S. (Exxon Res and Eng Co, Linden, NJ). *American Society of Mechanical Engineers, [Paper] ;* No. 79-GT-155, 8(1979).

Liquid synthetic fuels derived from nonpetroleum resources will play a major role in meeting future national energy demands. In the case of gas turbine applications, it is known that the different properties of these fuels can result in substantially altered combustion performance. Most importantly, decreased fuel hydrogen content resulting from an increased aromatic content has been observed to result in increased exhaust smoke and particulates as well as greater flame luminosity. This paper contributes empirical information and insight which allows the greater soot formation tendencies of low hydrogen content fuels to be better understood. A small scale laboratory device which simulates the strongly back-mixed conditions present in the primary zone of a gas turbine combustor is utilized. The results include gaseous combustion product distributions, incipient soot limits, and soot production (mg/l) for a variety of fuels. 28 refs.

0902 Alcohol Fuels

10425 (CONF-8009108—, pp 103-110) **Alcohol fuels.** Greenglass, B. 1980.

From Alternate sources of energy conference; New York, NY, USA (29 Sep 1980).

DOE alcohol fuel incentives are reviewed, including program management, funding, and tax incentives. (MHR)

10426 (PNL—3694) Methanol production with elemental phosphorus byproduct gas: technical and economic feasibility. Lyke, S.E.; Moore, R.H. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1981. Contract AC06-76RL01830. 200p. NTIS, PC A09/MF A01.

The technical and economic feasibility of using a typical, elemental, phosphorus byproduct gas stream in methanol production is assessed. The purpose of the study is to explore the potential of a substitute for natural gas. The first part of the study establishes economic tradeoffs between several alternative methods of supplying the hydrogen which is needed in the methanol synthesis process to react with CO from the off gas. The preferred alternative is the Battelle Process, which uses natural gas in combination with the off gas in an economically sized methanol plant. The second part of the study presents a preliminary basic design of a plant to (1) clean and compress the off gas, (2) return recovered phosphorus to the phosphorus plant, and (3) produce methanol by the Battelle Process. Use of elemental phosphorus byproduct gas in methanol production appears to be technically feasible. The Battelle Process shows a definite but relatively small economic advantage over conventional methanol manufacture based on natural gas alone. The process would be economically feasible only where natural gas supply and methanol market conditions at a phosphorus plant are not significantly less favorable than at competing methanol plants. If off-gas streams from two or more phosphorus plants could be combined, production of methanol using only offgas might also be economically feasible. The North American methanol market, however, does not seem likely to require another new methanol project until after 1990. The off-gas cleanup, compression, and phosphorus-recovery system could be used to produce a CO-rich stream that could be economically attractive for production of several other chemicals besides methanol.

10427 (PNL—3695(App.B)) Investigations on catalyzed steam gasification of biomass. Appendix B: feasibility study of methanol production via catalytic gasification of 2000 tons of wood per day. Mudge, L.K.; Weber, S.L.; Mitchell, D.H.; Sealock, L.J. Jr.; Robertus, R.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1981. Contract AC06-76RL01830. 124p. NTIS, PC A06/MF A01.

A study has been made of the economic feasibility of producing fuel grade methanol from wood via catalytic gasification with steam. The plant design in this study was developed from information on gasifier operation supplied by the Pacific Northwest Laboratory (PNL), operated by Battelle. PNL obtained this information from laboratory and process development unit testing. The plant is designed to process 2000 tons per day of dry wood to methanol. Plant production is 997 tons per day of methanol with a HHV of 9784 Btu per pound. All process and support facilities necessary to convert wood to methanol are included in this study. The plant location is Newport, Oregon. The capital cost for the plant is $120,830,000 - September 1980 basis. Methanol production costs which allow for return on capital have been calculated for various wood prices for both utility and private investor financing. These wood costs include delivery to the plant. For utility financing, the methanol production costs are respectively $.45, $.48, $.55, and $.69 per gallon for wood costs of $5, $10, $20, and $40 per dry ton. For private investor financing, the corresponding product costs are $.59, $.62, $.69, and $.83 per gallon for the corresponding wood costs. Both calculation methods include a return on equity capital in the costs. The thermal efficiency of the plant is 52.9%.

10428 Gasohol Utilization and Test Program. Arrigotti, R.J.; Wehrman, R.J.; Hurless, H.D. (Dept. of Energy, Portland, OR). pp 299-303 of Nonpetroleum vehicular fuels: symposium papers. Chicago, IL; Institute of Gas Technology (1980).

From Symposium on nonpetroleum vehicular fuels; Arlington, VA, USA (11 Feb 1980).

The Bonneville Power Administration (BPA), an agency of the Department of Energy, initiated its Gasohol Utilization and Test Program on July 31, 1979. For several months prior to that data we had collected and analyzed large masses of data and information about the experiences of others who were using gasoline-alcohol fuel mixtures. Almost without exception, reports of others' experiences were very positive in nature; their programs were huge successes with no problems. We were, therefore, quite surprised when our early efforts ran into some problems. Given this experience, we made personal contacts with some of the organizations who were using gasohol and learned that they too were encountering some problems. We beleive it is appropriate to provide a more balanced perspective between successes and problems when presenting the results of developmental programs. Others who are contemplating a move to gasohol should be spared the experience of

encountering and developing solutions to problems which have already been solved by others. They should not need to reinvent the wheel. For this reason we will discuss in some detail the problems we have encountered, solutions developed and ideas that are being pursued to solve problems not already solved.

0903 Inorganic Hydrogen Compound Fuels

10429 **(AD-A—086687) Control of vapor emissions from hydrazine-based fuels. Final report 1 Jul 79-30 Jun 80.** Lewandowski, G.A. (New Jersey Inst. of Tech., Newark (USA). Dept. of Chemical Engineering). 30 Jun 1980. 53p. NTIS, PC A04/MF A01.

A theoretical study was made of four control devices as applied to vapor emissions of four hydrazine-based fuels. The fuels considered were: monomethyl hydrazine (MMH), hydrazine, H-70, and unsymmetrical dimethyl hydrazine (UDMH). The control techniques considered were: refrigeration, carbon adsorption, incineration, and scrubbing. Of these, refrigeration is not practicable; and too little is known about carbon adsorption to make a determination of its effectiveness. Design criteria were established for incinerators and scrubbers, and both were sized. A choice between the two must be made on an economic basis.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 10479, 10480, 10481, 10482, 10483, 10484, 10485, 10486, 10487, 10488, 10489, 10492

10430 **Process for producing artificial fire logs.** Holder, M.E. US Patent 4,220,453. 2 Sep 1980. Filed date 11 Jun 1979. vp.

Process for producing artificial fire logs from a mixture comprising wood material and a binder, particularly a resin binder. Each log is formed in an individual mold, and a batch of mix required for a single log is divided into two approximately equal portions for loading into the mold. The mixture within the mold is compressed, and the mold is then closed. The closed mold is heated, and curing of the resin takes place within the capped mold. The finished log is then removed from the mold, which is reusable.

13 HYDRO ENERGY

1301 Resources And Availability

10431 (DOE/EV/73002—1(Vol.2)) **Alaska Regional Energy Resources Planning Project. Phase 2: coal, hydroelectric and energy alternatives. Volume II. Hydroelectric development.** Rutledge, G.; Lane, D.; Edblom, G. (Alaska State Div. of Energy and Power Development, Anchorage (USA)). 1980. Contract AT06-77EV73002. 177p. (DEPD—81-001-2). NTIS, PC A09/MF A01.

More than 600 sites for possible hydroelectric power development have been identified in Alaska. The power potential of these sites is 200 times as great as the currently developed hydroelectric capacity of 131 MW. Information is presented on the location and characteristics of Alaska's hydropower sites, licensing and cost requirements for site development, the environmental impact of hydroelectric development, and a review of hydroelectric technology including low-head, ocean wave, and tidal hydro power and the equipment used for hydro power conversion. (LCL)

10432 (DOE/EV/73002—1(Vol.3), pp 13.1-13.24) **Very small hydropower.** 1980.

In Alaska Regional Energy Resources Planning Project. Phase 2: coal, hydroelectric and energy alternatives. Volume III. Alaska's alternative energies and regional assessment inventory update.

The potential of small hydroelectric units for use in the rural and remote villages of Alaska is addressed. This potential is limited to combinations of flow and head that will give electrical energy production of about 12 kW or less. The history of small scale hydroelectric generation in Alaska is traced. Small hydroelectric technology and its applicability to Alaska are discussed. (MHR)

10433 **(FERC—0068) Planning status report: water resources appraisals for hydroelectric licensing.** (Federal Energy Regulatory Commission, San Francisco, CA (USA). San Francisco Regional Office). Jan 1981. 37p. NTIS, PC A03/MF A01.

This is one of a series of revised Planning Status Reports for major river basins in the United States. The original reports, which were prepared several years ago, are being revised as part of a program of Water Resources Appraisals for Hydroelectric Licensing. The revised reports provide updated information on water resources for use by the Federal Energy Regulatory Commission and its staff when considering hydroelectric licensing and other work. Data are presented on water resource developments, existing and potential, and on water use by existing and projected steam-electric generating facilities. Past and current planning studies are also summarized. The information presented was abstracted from available sources and involved no new analyses. Information is current as of October 1980 unless otherwise indicated.

1304 Regulations And Licensing

REFER ALSO TO CITATION(S) 11082

10434 **(PB—80-182835) Dam policy in Massachusetts.** Kaynor, E.R. (Massachusetts Univ., Amherst (USA). Water Resources Research Center). Dec 1979. Contract DI-14-34-001-8023. 103p. NTIS, PC A06/MF A01.

Recently, Massachusetts policy has strongly encouraged hydroelectric energy production with very little success in spite of sizeable state and federal incentives. Survey research reveals that part of the problem is that neither governmental officials nor the public at large are very interested in dams. There is little knowledge of how to proceed to make beneficial use of dams. There is also confusion over which governmental level has jurisdiction. This report recommends creation of a Dam Policy Deliberation Committee to further investigate dam functions and malfunctions in Massachusetts, and to recommend policy changes. It also recommends the creation of a state agency empowered to purchase unused, underused, or misused dams for development according to plans for maximum beneficial development.

1305 Economics And Management

10435 **(DOE/RA/04934—T1) Progress report for the first twenty-one months of the contract period.** (Franklin Pierce Law Center, Concord, NH (USA). Energy Law Inst.). 1980. Contract AC02-78RA04934. 56p. NTIS, PC A04/MF A01.

During the period of July 1, 1978, through March 31, 1980 in-depth research of the legal and institutional obstacles and incentives to the development of small scale hydroelectric power in all of the nineteen northeastern states was performed. Research into economic issues associated with the development of small scale hydroelectric power was undertaken by the project economist. Special research activities have been undertaken with respect to the federal dam safety programs, the National Pollution Discharge Elimination System requirements of the Federal Clean Water Act and the implications of those requirements to small scale hydroelectric power, riparian law on lake and reservoir fluctuation in the State of Maine, and the implications of Title II and IV of the Public Utility Regulatory Policies Act of 1978 to the development of small scale hydroelectric power. The results of these studies are reported. (LCL)

14 SOLAR ENERGY

10436 (CONF-8009108—, pp 14-15) **Role of the Solar Energy Research Institute.** Edesess, M. 1980.

From Alternate sources of energy conference; New York, NY, USA (29 Sep 1980).

The work of SERI and the regional Solar Energy Centers is reviewed briefly. (MHR)

10437 (SERI/RR—743-396(Vol.2)) Assessment of the labor market experiences of CETA-trained solar workers. Burns, B.A.; Mason, B.; Mikasa, G.Y. (Solar Energy Research Inst., Golden, CO (USA)). Dec 1980. Contract AC02-77CH00178. 146p. NTIS, PC A07/MF A01.

This study assessed solar training offered by CETA-funded programs and labor market experiences of program graduates. The initial research was restricted to programs within California, because the state is involved in a variety of solar-related activities, including development of jobs and training programs in solar energy. Interviews were conducted with 12 CETA solar training programs and graduates in 1979, in cooperation with California's SolarCal Office. Information on graduates includes demographics, educational and work experience, satisfaction with solar training, types of jobs found, wage levels, and job tenure. Program information includes length, types of training, and the number and kinds of solar systems installed. Results show that major programs problems were: limited funding; shortages of trained instructors; insufficient staff; need for local employment information; need for better defined role for unions; and pressures for high placement rates. The curricula involved general skills, skills specific to solar technologies, and basic job behavior and skills. The training involved both classroom and hands-on experience and was mainly tailored to participants and the local job market. Successful placement of program participants was relatively high; over half the initial job placements involved solar energy. Solar jobs appeared to pay more than nonsolar jobs. Participants generally felt that their training had prepared them adequately for their current work.

10438 SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979). 611p. (CONF-790541—(Vol.3)).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

103 of the 126 papers were entered into the data file separately. 23 papers were previously included in the data file and can be located by report number CONF-790541. (WHK)

10439 Solar energy technician curriculum design: an overview. Meyers, A.C. III. (Navarro Coll., Corsicana, TX). pp 1985-1989 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A consortium of educational institutions, under funding from the National Science Foundation, is involved in a project to design, develop, implement, test, evaluate, and disseminate an associate degree curriculum to train Solar Energy Technicians. A progress report on the status of this project is given. As of this time, Phase I has been completed and the work is currently progressing on Phase II.

10440 Teacher training workshops for effective information transfer. Zeller, T.M. (New Mexico Solar Energy Association, Santa Fe). pp 1990-1993 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

There is a great need for complete, accurate information in the curricula of our nation's schools. Unfortunately, much of the solar energy information available today is at best incomplete, if not inaccurate. Passive solar applications and small do-it-yourself applications, especially, seem to suffer from lack of exposure. Teacher training workshops have much potential for filling this need. The New Mexico Solar Energy Association with the help of the New Mexico State Department of Education has developed and presented workshops for Vocational-Technical teachers. These workshops combine balanced curriculum classroom sessions with a hands-on workshop during which small passive devices such as convective loop water and air collectors were built. Vocational Technical teachers were selected because they are directly involved with the teaching of building trades and their students will soon be entering a job market that will demand more and more solar skills. The workshops were very well received by the participants, especially the hands-on sessions. A follow-up program indicated that much solar information is being transferred to students as a result of these workshops. Many small projects and potentially some solar speculation houses are being built. We conclude that teacher training is extremely important in the area of solar energy and that a workshop program can be very effective in enhancing information transfer.

10441 Solar Energy Technician Curriculum design: Phase I work done at cooperating institutions. Meyers, A.C. III; Orsak, C.G. Jr.; Donnell, L.N.; Takacs, R.L.; Knowles, J.T.; Slater, W.J. (Navarro Coll., Corsicana, TX). pp 1999-2003 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The Phase I work done by the consortium involved in the Solar Energy Technician curriculum development project is described. The cooperating institutions as a project team have worked together to develop the Solar Energy Technician curriculum program which is presented.

1401 Resources And Availability

REFER ALSO TO CITATION(S) 10700

10442 (EMD—78-2131) Preparation of monthly maps of solar availability for New Mexico based on satellite photography. Technical completion report, February 1, 1979-July 30, 1979. Bahm, R.J. (New Mexico Univ., Albuquerque (USA). Bureau of Engineering Research). Jan 1981. 29p. Univ. of New Mexico, Albuquerque.

The objective of this project was to prepare maps of solar radiation availability for the state of New Mexico. The primary results are: (1) a set of 12 maps, one for each month, of solar radiation availability over the state of New Mexico. See Figures 1-12 at the end of this report; and (2) the conclusion that long term solar radiation availability actually varies little over the state and that long term values for Albuquerque may be used over the entire state for most solar space heating design purposes.

10443 (SERI/TR—721-960) Spectral analysis of ambient weather patterns. Anderson, J.V.; Subbarao, K. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1981. Contract AC02-77CH00178. 8p. (CONF-810405—7). NTIS, PC A02/MF A01.

From 3. annual systems simulation, economic analysis/solar heating and cooling operational results conference; Reno, NV, USA (27 Apr 1981).

A Fourier spectral analysis of ambient weather data, consisting of global and direct solar radiation, dry and wet bulb temperatures, and wind speed, is given. By analyzing the heating and cooling seasons independently, seasonal variations are isolated and a cleaner spectrum emerges. This represents an improvement over previous work in this area, in which data for the entire year were analyzed together. As a demonstration of the efficacy of this method, synthetic data constructed with a small number of parameters are used in typical simulations, and the results are compared with those obtained with the original data. A spectral characterization of fluctuations around the moving average is given, and the changes in the fluctuation from season to season are examined.

10444 (SOLAR/0010—81/01) January 1981 environmental data for sites in the National Solar Data Network. (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). Jan 1981. Contract AC01-79CS30027. 241p. NTIS, PC A11/MF A01.

Insolation, temperature, wind, and humidity data recorded during the month of January 1981, at the National Solar Data Network for residential and commercial building solar demonstration sites throughout the United States are presented. The insolation tables present the total, diffuse, direct, maximum, and extraterrestrial radiation. The temperature tables give the average, daytime, nighttime, maximum, minimum and inlet-water temperatures for the solar sites. Additional tables are presented for some of the sites, supplying either wind or relative humidity data, or both. These data are used to determine the thermal performance of the solar systems. (WHK)

10445 Historical development and present status of solar radiation measuring instruments. Yellott, J.I. (Arizona State Univ., Tempe). pp 2169-2173 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The measurement of solar radiation intensity began in 1838 when the French physicist Pouillet introduced both an instrument for measuring the sun's direct beam radiation and the name, pyrheliometer, which we still apply to such devices. Electrical methods of radiation measurement were adopted in 1896 by Angstroem who introduced his comparison-type pryheliometer, the first to deserve the term absolute. Charles G. Abbot began his fifty years of work in solar radiometry in 1905 at the Smithsonian Institution in Washington, DC. His silver disk and water-flow pyrheliometers were used to establish the Smithsonian radiation scales which remained in use until 1956. Between the two World Wars, electrical instruments were introduced for the continuous measurement of direct, diffuse and total irradiance, and integrators came into use for giving values of hourly and daily irradiation. With the advent of the Space Age, improved absolute radiometers have been introduced and with them came a new radiometric standard to replace IPS 1956. A brief historical record of these developments is presented.

10446 Evaluation of the availability and quality of data on solar radiation. Bahm, R.J. (Univ. of New Mexico, Albuquerque). pp 2174-2177 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Many persons have collected solar radiation data throughout the world for a variety of purposes. Although considerable effort has been spent on the collection of this data and its reduction into a number of useful forms, there is a general lack of quality data for many purposes. Sources of solar radiation data throughout the world are identified. Some problems with the data are reviewed and some suggestions for avoiding those problems or correcting them are given. Some current US programs for improving the knowledge of our solar resource are outlined, and some elements of an international program plan for the future are suggested.

10447 Investigation of the SOLMET Typical Meteorological Year. Freeman, T.L. (Atlas Corp., Santa Cruz, CA). pp 2183-2187 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

An analysis of the Typical Meteorological Years (TMYs) developed by Sandia Labs is undertaken. Computer simulations of typical solar heating and cooling systems using both the TMYs and the entire SOLMET period of record are compared for selected sites to assess how well the TMYs represent the long term for the purpose of design and analysis of solar thermal systems. It is concluded that the TMYs adequately represent the long term in spite of some shortcomings.

10448 Development of a solar model year from National Weather Service chart data. Craig, J.I.; Jeter, S.M.; Hartman, T.L. III; Hill, J.M. (Georgia Inst. of Tech., Atlanta). pp 2188-2192 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The development of a solar model year directly from National Weather Service chart data archived at the National Climatic Center is described. A pseudo year model is constructed by selecting from all available months those 12 which most nearly match the long term monthly characteristics in a weak statistical sense. The months are selected to most nearly match the first two moments of monthly distributions of the daily total global insolation. No attempt is made to match other meteorological characteristics. The chart data of daily global insolation for each month were digitized at 15 minute intervals and are corrected for long term instrument drift. The correction is based on a linear regression analysis of the daily total insolation measurement for the clearest of each group of 40 days over the lifetime of the particular instrument.

10449 Solar energy measurements and solar radiation model for Blytheville, Arkansas. Turner, W.D.; Mujahid, A. (Univ. of Arkansas, Fayetteville). pp 2198-2202 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The equations developed can be used to predict total horizontal solar radiation based on cloud cover information alone with very good results. The regression constants developed herein for the Blytheville, AR region should be applicable to a large geographic region of the US, principally, the agricultural areas of the Midwest and South. The direct normal predictions based on total horizontal measurements for Blytheville matched the recorded data very well, and also accurately predicted the direct normal for Houston, Texas. The range of applicability of the equations still has to be determined. Future research efforts by the authors will expand the models developed herein to determine their limitations and the extent of their applicability.

10450 Cloud-cover radiation model producing results equivalent to measured radiation data. Atwater, M.A. (Center for the Environment and Man, Inc., Hartford, CT); Robinson, G.D.; Lunde, P.J. pp 2203-2207 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A cloud cover solar radiation model using standard meteorological data that includes effects of pollutants is described. Pollutant aerosol depletion factors, calculated as monthly averages for the midwestern US, averaged 7.5 percent of non-aerosol solar irradiation. SOLMET rehabilitated solar radiation data from Nashville, Tennessee was compared with model results for 1970 to 1974 with the annual difference less than one percent and monthly differences less than 10 percent.

10451 Attenuation of solar radiation in the atmosphere. Mani, A.; Chacko, O. (Raman Research, Inst., Bangalore, India). pp 2208-2212 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The results of measurements of the solar radiant energy absorbed and scattered in the atmosphere are presented. Since much of the information on solar irradiance at the ground, is obtained by computation from extraterrestrial radiation data, it is important to know precisely the actual energy that is absorbed and scattered in its passage through the atmosphere, for the accurate estimation of the radiant energy received at the ground. Various models exist for the estimation of daily totals of global solar radiation under clear sky and cloudy conditions, taking these effects into consideration and assuming average values for the ozone and water vapor content and the turbidity of the atmosphere. In the present investigation atmospheric attenuation of solar radiation has been calculated from measured values of ozone and water vapor content and turbidity in the atmosphere, at two stations Bangalore (950 m.a.s.l.) and Nandi Hills (1479 m.a.s.l.). Direct measurements of direct solar radiation for the whole spectrum and various spectral regions were made at Bangalore and Nandi using Angstrom pyrheliometers fitted with broad band pass-filters during the clear months January to May 1979. Global solar radiation and sunshine duration measurements were also made at both stations. Using direct measurements of the total ozone and water vapor content and atmospheric turbidity, direct, diffuse and global solar radiation values at the ground were computed from extraterrestrial values of radiation for clear sky conditions. The results are compared with actual measurements and earlier observations of direct solar radiation at other high level stations. The importance of atmospheric turbidity measurements in the computation of solar radiation is discussed.

10452 Stochastic model for hourly solar radiation in Thailand. Exell, R.H.B.; Biswal, R.N. (Asian Inst. of Tech., Bangkok, Thailand). pp 2213 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

10453 **Measurement of solar irradiance on a tilted surface.** Justin, B. (Pilkington Bros. Ltd., Ormskirk, Great Britain); Pye, D.B. pp 2219-2221 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The measurement of solar irradiance on a tilted plane has been compared using two methods. The irradiance was calculated from the measured total and diffuse irradiance in the horizontal plane assuming an isotropic sky and compared with that measured in the tilted plane. Differences were observed which were variable and depended on the weather conditions. These differences were found to depend on how the tilted solarimeter was mounted, especially on whether there was a significant view factor between the sky and the back of the instrument. It is concluded that provided errors of about 5% can be tolerated, the irradiance on a tilted surface may be estimated from measurements with horizontally placed instruments, assuming sky isotropy. If a tilted instrument is used it is extremely important to ensure both adequate radiation shielding and ventilation around the back of the instrument.

10454 **Method of measuring sky temperature.** Dunkle, R.V.; Christie, E.A.; Cooper, P.I. (Commonwealth Scientific and Industrial Research Organization, Highett, Australia). pp 2222-2226 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

For radiation heat exchange, the sky is assumed to be a blackbody at some equivalent temperature known as the sky temperature. When correlating measured collector performance with meteorological data, it is desirable to have complete information on all the meteorological variables, one of which is the sky temperature. A new system for measuring sky temperature based on a heat flow meter has been constructed and calibrated. The heat flow meter is mounted in a constant velocity air stream to minimize variable convective heat transfer effects caused by the wind. The exposed surface of the heat flow meter, which contains a thermocouple embedded in the metal substrate for measuring surface temperature, is coated with a white paint having a low solar absorptance and a high thermal emittance. The lower polished metal surface of the heat flow meter faces a radiation shield. The analysis on which the design was based is presented together with methods of calibration and results of measurements made with the device. The results are encouraging and indicate that there is a need for further work to determine the absolute performance of similar devices over a wide range of conditions.

10455 **Spectral irradiance of cloudless sky: comparison between measured and computed data.** Guzzi, R. (Consiglio Nazionale de le Ricerche, Bologna, Italy); Grinzato, E.; Rizzi, R.; Vindigni, S. pp 2232-2236 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A first comparison is presented between measured and computed spectral sky irradiance. The computations are done using a model developed by Sobolev. From the comparison it appears that the pattern of calculated irradiance is quite similar to the measured one in the half-hemisphere containing the sun while discrepancies are evident in the opposite half-hemisphere and at large zenith angles.

10456 **Variations in coastal climates as they affect solar system design and performance, illustrated by graphical methods of analysis.** Bahm, R.J. (Bickle/CM Inc., Albuquerque, NM); Ben-David, S. pp 2241-2244 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The three-dimensional SOLTMP data space is illustrated. The axis along the front of the plane is mean daily temperature °F. The axis along the left side of the plane is daily total solar radiation as a % of extraterrestrial solar radiation. Characteristic climates are illustrated by plotting percent of days having the combined characteristics of temperature and solar radiation on the vertical axis. Solar system performance characteristics are illustrated by plotting the solar fraction on the vertical axis. The possibilities of utilization of overlays of the system performance graph with the climate graph are briefly discussed. (WHK)

10457 **Determination of climatic/building zones for the Tennessee Valley region.** Finsen, P.I.; Beebe, R.C. (Tennessee Valley Authority, Knoxville). pp 2245-2248 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Climatic/building zones have been determined as part of the Climatic Data Base of Design Guidelines. They are reflective of the renewed interest in utilizing natural energies as a means of tempering human comfort in the built environment and should provide designers a more objective approach toward this goal.

10458 **Measurement of clear sky solar insolation at Edmonton, Alberta, Canada.** Sadler, G.E. (Univ. of Alberta, Edmonton). pp 2249-2253 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The average energy measured at hour angles 0 to 6 for each month of the year of the normal incidence energy and the energy transmitted by the OG1, RG2, and RG8 filters are reported. Horizontal surface energy, horizontal diffuse energy and horizontal surface ultraviolet energy are also reported. In addition, the variation in measured energy with altitude is investigated by calculating a yearly average for each energy quantity at increasing solar altitude. Other characteristics such as ratio of filter measurements to normal incidence energy are included.

1403 Economics

10459 **(CONF-8009108—) Alternate sources of energy.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy). 1980. 165p. NTIS, PC A08/MF A01.

From Alternate sources of energy conference; New York, NY, USA (29 Sep 1980).

Eleven papers are included. A separate abstract was prepared for each for Energy Research Abstracts (ERA); seven were selected for Energy Abstracts for Policy Analysis (EAPA).

10460 (CONF-8009108—, pp 2-13) **Federal incentives.** Schirmer, K. 1980.

From Alternate sources of energy conference; New York, NY, USA (29 Sep 1980).

The following federal incentives are reviewed: tax credits, research and development, infrastructure and institutions, and information dissemination. (MHR)

10461 (CONF-8009108—, pp 16-28) **Active and passive solar heating and cooling and solar hot water of buildings.** Morse, F. 1980.

From Alternate sources of energy conference; New York, NY, USA (29 Sep 1980).

The following topics are covered relative to active and passive solar heating and cooling of buildings: market size, technologies, the product development sequence, solar economics, solar growth rate and future, Federal policies, and investment opportunities. (MHR)

10462 (CONF-8009108—, pp 29-36) **Solar thermal: industrial and agricultural process-heat applications.** Braun, G. 1980.

From Alternate sources of energy conference; New York, NY, USA (29 Sep 1980).

The investment possibilities of the following technologies are discussed: linear concentrating collectors, parabolic dish collectors, central receiver power plants. The industrial and agricultural uses of solar process heat are explored. Foreign competition in solar technologies is discussed. (MHR)

10463 **Solar energy financing: variable loan payments in an energy-savings paid loan program.** Danziger, R. pp Paper 6, 183-192 of Energy: the new rules. Newman, D.T. (ed.). Santa Monica, CA; Management Education Corporation (1979).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

To eliminate impediments to the widespread utilization of solar energy devices, an Energy-Savings-Paid Load Program is proposed. The program is structured so that the loan is repaid with the utility and tax savings attributable to the installation and use of a solar product. The utility bill aspect allows a consumer to repay the loan at the rate that the solar device lowers the users energy costs. The paper discusses the impact of the Uniform Consumer Credit Code balloon payment provisions on such a loan program. The programs proposed are an ideal component in plans to spur solar retrofit installations since the lid on utility bills stabilizes cash flow, and the high initial cost of solar installation is eliminated. All consumers benefit as payments are by definition within the reach of even the low-income consumer. (MCW)

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 10391, 10479, 10480, 10481, 10482, 10483, 10484, 10485, 10486, 10487, 10488, 10489, 10563, 10587, 10588, 10603, 10702, 11045, 11094, 11561, 11598, 11678, 11679, 11683

10464 **(DOE/ER—0096) Environmental assessment for the satellite power system concept development and evaluation program-electromagnetic systems compatibility.** Davis, K.A.; Grant, W.B.; Morrison, E.L.; Juroshek, J.R. (Battelle Pacific Northwest Labs., Richland, WA (USA); Institute for Telecommunication Sciences and Aeronomy, Boulder, CO (USA)). Jan 1981. Contract AC06-76RL01830. 93p. NTIS, PC A05/MF A01.

The EMC analysis addressed only the direct effects of electromagnetic emissions from the SPS on other technological systems. Emissions were defined quite broadly, including not only those from the microwave system, but also thermal blackbody emission and scattered sunlight from the satellite. The analysis is based on the design for an SPS as described in the Reference System Report and some quantitative conclusions, e.g., ranges from rectenna sites at which effects are expected are specific to that design. The methodology and qualitative conclusions, however, apply to an SPS concept using microwave power transmission. Quantitative conclusions have been obtained parametrically and can be adjusted as SPS designs change. The electromagnetic environment that the Reference System would produce, and in which other systems would have to function, is described. As an early part of the EMC Assessment, the problems expected for a hypothetical rectenna site, in the Mojave Desert of southern California, were analyzed in detail. This effort provided an initial quantitative indication of the scope of potential EMC problems and indicated the importance of EMC considerations in rectenna site selection. The results of this analysis are presented. The effects of SPS microwave emissions on important categories of electronic systems and equipment are summarized, with many examples of test results and demonstrated techniques for mitigation of problems encountered. SPS effects on other satellite systems are presented. Astronomical research frequently involves measurement of extremely low levels of electromagnetic radiation and is thus very susceptible to interference. The concerns of both radio astronomy with microwave emissions from SPS and optical astronomy with sunlight scattered from SPS spacecraft are discussed. Summaries of mitigation techniques, cost estimates, and conclusions are presented. (WHK)

10465 **New approach to public solar energy education.** Martindale, W.R.; Mussulman, R.L.; Warrington, R.O. (Montana State Univ., Bozeman). pp 1971-1974 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The severity of Montana winters, the frequency and duration of cloudy periods, and the relatively low cost of non-renewable energy combine to make the economics of solar energy installations unfavorable in Montana. A very limited number of Montanans have enough technical training to design economical solar systems under these circumstances. Two public education programs have been started to increase the level of solar energy knowledge among home builders and their clients. Other such programs tend to be either technical courses for highly trained technical people or how-to courses for lay people. The programs described address the lay public, but the programs are unique in that they include much of the technical information normally found only in courses for technically trained audiences. Economic evaluation of a solar system can be accomplished through use of this technical information.

10466 **Role of rural women in the transfer of solar technologies to developing countries.** Saltonstall, R. (Solar Energy Research Inst., Golden, CO). pp 2041 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

10467 **Environmental and socioeconomic aspects of selected dispersed solar electric technologies.** Sim, S.R. (Connell Metcalf and Eddy, Coral Gables, FL). pp 2047-2051 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The environmental impacts expected to result from widespread use of certain dispersed solar electric technologies appear to be relatively minor when compared with those emanating from existing electricity generating facilities. Those impacts which will occur will primarily be extremely localized health concerns. Conversely, significant socioeconomic barriers to the deployment of such onsite systems may exist. The most significant of these appear to involve the issues of interface with electrical utilities, zoning, building codes, safety, insurance and public acceptance.

10468 **Socioeconomic factors affecting the deployment of central solar power plants.** Mohrman, B.A. (Stone & Webster Engineering Corp., Boston, MA); Cleveland, J.A.; Ladd, E. pp 2052-2055 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Regional impacts resulting from commuting and relocating work forces are addressed for the Southeast and Southwest, for increasing numbers of solar electric generating plants through the year 2000. Socioeconomic considerations in the deployment of solar electric plants are discussed in relation to the work force requirements for the different solar technologies at varying regional deployment levels. These considerations include impacts on housing, transportation and the local, as well as regional, economy. For this evaluation, solar deployment is defined for each region as the nominal amount of solar electric generating capacity as a percentage of the total installed electric generating capacity in the year 2000. Solar deployments ranging from as little as 1 percent to as much as 20 percent of the region's total electric capacity are evaluated. (WHK)

10469 **Solar installer training and the US Department of Energy.** Langford, D. (Dept. of Energy, Washington, DC). pp 2068-2072 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The lack of qualified solar system installers has proven to be a serious deterrent to the commercialization of solar energy both in the United States and abroad. The problems caused by incorrectly installed solar systems erode consumer confidence in the solar industry and lead to increased installation costs. To accelerate the development of a qualified, ready solar installer workforce, the US Department of Energy (DOE) is working with industry, communi-

ty colleges, vocational schools, and other Federal agencies. The DOE solar installer training program is a comprehensive effort to provide in-service training to both the organized and unorganized industry workforce and to provide the basic skills training required to install solar systems to low income, unemployed individuals. DOE's solar installer training projects are described and DOE's training plans for 1980 are discussed. This information should be of interest to governments, educators, and private developers who are involved in the commercialization of solar energy.

10470 **Establishing workable solar standards.** Carlough, E.J.; Cosel, W.J. pp 2082-2084 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

It is proposed that the Federal government set up an FHA type insurance program that will guarantee that the solar installation will perform as represented by the seller. The builder should integrate this guarantee into his basic guarantee. Because of its Federal backing, this guarantee will survive the builder or contractor so that the consumer can get satisfaction regardless of the financial stability of the supplier. A revolving fund should be set up to supply the funds when necessary. Replenishing this fund can take several paths. Companies that belong to the program might pay dues based on volume of sales. On the other hand, the homeowner may purchase a service and maintenance contract that will take effect after the builders complete guarantee expires. Equipment suppliers should also be brought into the program so that faulty equipment can be replaced and the error charged to the manufacturer of shoddy equipment. (WHK)

10471 **Myths and practices of solar commercialization.** Yudelson, J.; Parker, W. (California State SolarCal Office, Sacramento). pp 2086-2090 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The Federal government and the four Regional Solar Energy Centers are all preparing commercialization plans for passive solar uses and solar water heating. These plans are flawed in conception and likely to be insufficient in implementation, largely because of unexamined assumptions and unarticulated myths about solar commercialization. These myths involve improper methods of energy accounting, overextended faith in the efficacy of government programs, poor understanding of the complex nature of the economic performance of solar energy systems, and inadequate attention to social issues central to achieving a rapid transition to dependence on renewable energy sources. These myths are examined critically and a variety of alternative means for reformulating them into more useful guides for solar commercialization is suggested.

10472 **Sun rights development for the Solar Total Energy-Large Scale Experiment at Shenandoah, Georgia.** Lambert, R. (General Electric Co., King of Prussia, PA); Zimmerman, J.; Burvee, D.B.; Craig, J.; Franz, D. pp 2091-2095 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

An account of the technical considerations and interactions among the parties during the development of the Solar Easement Agreement applicable to the Solar Total Energy-Large Scale Experiment at Shenandoah, Georgia is presented. Although the agreement is specifically tailored to the Shenandoah Project Site, the review of the key technical results and practical resolutions of the different interests of the several parties involved in the Shenandoah Project will be of benefit to anyone involved in present and future solar projects where sun rights must be established and protected. Key provisions of the solar easement agreement which applies to all nearby properties are presented.

10473 **Model solar zoning ordinance.** Eisenstadt, M.M. (Mel Eisenstadt & Associates, Inc., Albuquerque, NM). pp 2096-2100 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A synopsis of an ordinance for solar zoning is presented. If greater detail is required, the reader is referred to Report No. NMEI 76-103 available from the New Mexico Energy Institute, 117 Richmond, N.E., Albuquerque, NM. The format used consists of first presenting the wording of each section of the ordinance, and then commenting on the section.

10474 **Public Law Number 591 taxes solar energy at up to 46%.** Schuler, H.F.; Rost, D.F.; Ameduri, G. (General Extrusions Inc., Youngstown, OH). pp 2121-2125 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The United States Federal Government is taxing solar energy at up to 46%. The fossil fuel cost is deductible under current law. When a solar energy system displaces a fossil fuel expense, those dollars look like profit in the tax laws and are taxed the same as that company's profits. The effect is, of course, to discourage investment in solar energy systems. The output from a solar system can be measured and a deduction allowed the company for its value. This would not be an extra subsidy to solar but only establishing a parity with current fossil fuels.

10475 **Ways to implement government incentives for passive solar energy applications.** Beyard, M.D.; Weiss, S. (PRC Energy Analysis Co., McLean, VA). pp 2126-2130 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Passive solar energy must be explicitly defined in the regulations used to implement solar incentive programs. These regulations need to be flexible, yet precise enough to account for the administrative differences between passive and active systems.

1405 Solar Energy Conversion

10476 (CONF-8009108—, pp 69-80) **Photovoltaic energy systems.** Maycock, P. 1980.

From Alternate sources of energy conference; New York, NY, USA (29 Sep 1980).

The DOE photovoltaic program is discussed, and the state-of-the-art of solar cell fabrication and economics is reviewed. Solar cell manufacturers are listed, and photovoltaic market penetration is briefly discussed. (WHK)

10477 **(CONF-8009123—1) Methane production from marine biomass.** Chynoweth, D.P.; Srivastava, V.J. (Institute of Gas Technology, Chicago, IL (USA)). 1980. Contract AC01-76ET10163. 27p. NTIS, PC A03/MF A01.

From International symposium on biogas, microalgae, and livestock wastes; Taipei, Taiwan (15 Sep 1980).

The overall concept of the giant brown kelp farm and conversion system, the integrated research program engaged in its study, and IGT's work on biogasification process development are discussed. A summary of results to date on anaerobic digestion will be emphasized. (MHR)

10478 **(DOE/ER/04178—4) Photochemical energy storage: studies of inorganic photoassistance agents. Progress report, December 17, 1979-March 31, 1981.** Wrighton, M.S. (Massachusetts Inst. of Tech., Cambridge (USA)). Dec 1980. Contract AS02-76ER04178. 31p. NTIS, PC A03/MF A01.

Research progress has been made in the study of p-type semiconductor (photocathode) electrode materials. A number of small band gap (E/sub g/ approximately equal to 1.1 to 1.4 eV) p-type semiconductors have been demonstrated to have poor H_2 evolution kinetics despite the fact that a reasonable output photovoltage (E/sub V/) compared to E/sub g/ could be expected. Special emphasis has been on p-type Si (E/sub g/ = 1.1 eV) and p-type InP (E/sub g/ = 1.35 eV). Both of these materials give poor kinetics for H_2 evolution from H_2O, while the kinetics for N,N'-dimethyl-4,4'-bi-

pyridinium, MV^{2+}, reduction to MV^{+} are good at a pH where $E^{0}(H_2O/H_2)$ is the same as $E^{0}(MV/sup\ 2+/+/)$. A surface derivatizing reagent from diquarternizing 4,4'-bipyridine with 1-bromo-3-trimethyloxysilylpropane can be used to functionalize p-type Si with polymeric quantities of redox reagent. The surface-confined bipyridinium reagent, (PQ^{2+})/sub surf./, can be photoreduced to (PQ^{+})/sub surf./ and this reduced species can be used to effect H_2 evolution if a Pt catalyst is incorporated into the polymer. Efficiency for conversion of monochromatic 632.8 nm light to H_2 exceeds 6%, compared to much less than 1% for the naked p-type Si without the surface catalyst system. Studies of n-type semiconductor (photoanode) electrode materials modified with biferrocene-based redox mediators for $I^{-} \rightarrow I_3^{-}$ oxidation have been undertaken for comparison to ferrocene-based reagents for the same reaction; a five- to ten-fold overall improvement in heterogeneous $I^{-} \rightarrow I_3^{-}$ rate can be achieved using the two-electron mediator compared to the one-electron transfer system.

10479 **(DOE/ET/20055—1) Advanced system demonstration for utilization of biomass as an energy source. Environmental report.** McCollom, M. (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). 1979. Contract AC06-77ET20055. 488p. NTIS, PC A21/MF A01.

The conclusions and findings of extensive analyses undertaken to assess the environmental impacts and effects of the proposal to assist in an Advanced System Demonstration for Utilization of Biomass as an Energy Source by means of a wood-fueled power plant. Included are a description of the proposed project, a discussion of the existing environment that the project would affect, a summary of the project's impacts on the natural and human environments, a discussion of the project's relationships to other government policies and plans, and an extensive review of the alternatives which were considered in evaluating the proposed action. All findings of the research undertaken are discussed. More extensive presentations of the methods of analysis used to arrive at the various conclusions are available in ten topical technical appendices.

10480 **(DOE/ET/20055—1(App.A)) Advanced system demonstration for utilization of biomass as an energy source. Technical Appendix A: project description. Environmental report.** McCollom, M. (ed.). (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). 1979. Contract AC06-77ET20055. 52p. NTIS, PC A04/MF A01.

The following aspects of the facility are described: external appearance, steam-electric system, fuel supply system, water supply system, water effluent treatment, ash disposal system, atmospheric emission control, noise control system, transmission and grid, plant secondary system, fire protection system, and modifications to existing site features. The operational monitoring programs include: air quality, water quality, ecological, and ash composition. (MHR)

10481 **(DOE/ET/20055—1(App.B)) Advanced system demonstration for utilization of biomass as an energy source. Technical Appendix B: air quality studies. Environmental report.** (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). 1979. Contract AC06-77ET20055. 114p. NTIS, PC A06/MF A01.

The plant site studies include: climate, present ambient air quality, construction impacts, and operation impacts. The fuelwood harvest region studies include: present environment and harvesting impacts. The use of the Valley Model for alternative sites analysis is discussed. (MHR)

10482 **(DOE/ET/20055—1(App.C)) Advanced system demonstration for utilization of biomass as an energy source. Technical Appendix C: water quality studies. Environmental report.** High, M. (ed.). (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). 1979. Contract AC06-77ET20055. 111p. NTIS, PC A06/MF A01.

The following plant site and fuelwood harvest region studies are covered: hydrology and water resources, hydrologic and water quality impacts, and aquatic ecology of the site. (MHR)

10483 **(DOE/ET/20055—1(App/D)) Advanced system demonstration for utilization of biomass as an energy source. Technical Appendix D: terrestrial ecosystems and forestry. Environmental report.** McCollom, M. (ed.). (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). 1979. Contract AC06-77ET20055. 161p. NTIS, PC A08/MF A01.

The existing terrestrial ecosystems at the plant site and impacts on them are described. The following are discussed for the fuelwood harvest region: forest soils, forest types and ecological succession, nutrient cycles in the forest ecosystem, fauna of the ecosystem, forest practices in the harvest region, and long-term productivity of the forest resource. (MHR)

10484 **(DOE/ET/20055—1(App.E)) Advanced system demonstration for utilization of biomass as an energy source. Technical Appendix E: socioeconomic studies. Environmental report.** Peterson, E. (ed.). (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). 1979. Contract AC06-77ET20055. 96p. NTIS, PC A05/MF A01.

The socioeconomic studies of the present plant site community and fuelwood harvest region include the following: population, housing, income and employment, education, community services, health and social services, crime, and economic base. The potential plant impacts on the following are discussed: employment, income, state revenues, population, housing, education, community services, health services, and the wood products industry. (MHR)

10485 **(DOE/ET/20055—1(App.F)) Advanced system demonstration for utilization of biomass as an energy source. Technical Appendix F: transportation studies. Environmental report.** McCollom, M. (ed.). (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). 1979. Contract AC06-77ET20055. 43p. NTIS, PC A03/MF A01.

Existing transportation sytems and potential traffic impacts are discussed. Among the topics covered are roads, railroads, bridges, transportation needs and truck impacts. (MHR)

10486 **(DOE/ET/20055—1(App.G)) Advanced system demonstration for utilization of biomass as an energy source. Technical Appendix G: land use studies. Environmental report.** McCollom, M. (ed.). (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). 1979. Contract AC06-77ET20055. 39p. NTIS, PC A03/MF A01.

Present land use, future land use with the project, and impacts of the proposed project are discussed for the plant site community and the fuelwood harvest region. (MHR)

10487 **(DOE/ET/20055—1(App.H)) Advanced system demonstration for utilization of biomass as an energy source. Technical Appendix H: recreation, scenic and noise studies. Environmental report.** McCollom, M. (ed.). (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). 1979. Contract AC06-77ET20055. 46p. NTIS, PC A03/MF A01.

The aesthetic environments of both the plant site and the harvest region are discussed along with the impacts of the proposed project. The increase in noise at the plant site and the impact on recreation in the harvest region are explored. (MHR)

10488 **(DOE/ET/20055—1(App.I)) Advanced system demonstration for utilization of biomass as an energy source. Technical Appendix I: historical, archaeological, and cultural studies. Environmental report.** McCollom, M. (ed.). (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). 1979. Contract AC06-77ET20055. 33p. NTIS, PC A03/MF A01.

As Maine and New Hampshire were settled relatively early in United States history, both greater Portland and the settled interior regions are rich in historic resources. Many archaeologic sites are thought to exist in the fuel wood harvest region, particularly along the inland waterways and ocean shoreline, but only a small percentage have actually been discovered. Development in greater Portland has largely destroyed this region's archaeological potential. Cultural resources are also found in the populated areas. Construction and operation of the proposed wood-fired facility will not

have any impact on historic, archaeologic, or cultural resources of the fuelwood harvest region; however, harvesting activities have the potential to destroy archaeologic resources, particularly where truck roads and skidding networks coincide with archaeologic sites.

10489 (DOE/ET/20055—1(App.J)) Advanced system demonstration for utilization of biomass as an energy source. Technical Appendix J: alternatives studies. Environmental report. McCollom, M. (ed.). (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). 1979. Contract AC06-77ET20055. 103p. NTIS, PC A06/MF A01.

A comprehensive review of a wide range of alternatives to the proposed action, the commercial demonstration of an industrial cogenerating facility fired with wood fuels is provided. An extensive effort has been devoted to the evaluation of all reasonable alternatives to this project. A number of possible actions were also briefly considered, but, for various reasons, they were found not to be appropriate at present for a commercial-scale demonstration of an alternative energy source. The critical characteristics of the wood-fueled commercial demonstration project at Westbrook are considered to be: industrial cogeneration of power; the production of 510,000 pounds per hour of industrial process steam; the production of approximately twenty-five megawatts of electric generating capacity, some of which would be available to a public utility in southern Maine; and the consumption of 2,000 tons of wood fuel per day. Each of the alternatives examined in this appendix offers a different option for one or several of the characteristics of the project listed above. As a whole, the appendix describes the range of possible actions that the US Department of Energy and its contractors have considered.

10490 (DOE/ET/20521—4) Electrodeposited amorphous silicon for solar applications. Final report, September 15, 1978-September 14, 1979. Austin, A.E.; Agrawal, A.K.; Noel, G.T. (Battelle Columbus Labs., OH (USA)). 8 Nov 1979. Contract AC03-78ET20521. 64p. NTIS, PC A04/MF A01.

Research on the development of electrodeposited amorphous silicon for solar cell applications is described. Research has been conducted on the first two tasks: (1) the development of semiconductor doping of electrodeposited amorphous silicon, and (2) the characterization of physical and electronic properties of the doped silicon. For the doping of electrodeposited silicon, the electrolytic reduction and codeposition of possible n- and p-type dopants was investigated. Three dopants, B, Li, and Ga, were found that could be codeposited with the silicon. Annealing was investigated for activation of these dopants in the silicon. The deposition parameters of temperature and cathode substrates were studied. The hydrogen content of electrodeposited silicon decreases from about 30 atom percent at 35 C with increasing temperature of deposition. Electrodeposition onto an aluminum substrate was demonstrated in addition to the prior use of titanium substrates. The electronic properties of doped deposits were studied by differential capacitance and Schottky diode measurements. The dopants were found to be activated by annealing in the range of 350 to 400 C. This was also found to be the temperature range for the start of hydrogen release from the silicon. Both n- and p-type doping has been demonstrated.

10491 (DOE/ET/23043—T1) Chalcogenide-glass solar cells. Final technical progress report, 6 April 1979-31 October 1980. Adler, D.; Haggerty, J.S. (Massachusetts Inst. of Tech., Cambridge (USA)). 1980. Contract AC03-79ET23043. 66p. NTIS, PC A04/MF A01.

Chalcogenide glasses, modified and unmodified, were investigated as potential components of thin-film solar-cell devices. A wide array of glasses in the Se-Te-As system were prepared by rf-sputtering in either Ar or Ar/H_2 atmospheres and characterized optically and electrically. Some films were co-sputtered with small concentrations of Li, Na, or K. Glasses with optical gaps of 1.2 to 1.5 eV were investigated in solar-cell configurations. The Se-Te glasses without As exhibited transient behavior, the time-varying effects persisting for the order of several minutes or more. These transients were explained by invoking the unique properties of the valence alternation pairs (VAPs) which must exist in such glasses in large densities. Small concentrations (1 to 5%) of As effectively suppressed the transient effects. Both hydrogenation and alkali incorporation increased the defect density in all chalcogenide glasses investigated. It was concluded that both modifiers enter the network as chain enders. None of the alloy or modified glasses exhibited photoresponse within an order of magnitude of that of pure a-Se. An array of Schottky-barrier solar cells were fabricated, employing both semiconductor homojunctions and heterojunctions. Multicomponent alloys yielded low values both for V/sub oc/ and J/sub sc/, although both were vastly improved by the use of pure a-Se in the cell. The possibility of improving the efficiency of a-Si:H solar cells by the use of an a-Se heterojunction was investigated. Although the devices exhibited a much improved V/sub oc/, the presence of interface states near the heterojunction degraded the observed values of J/sub sc/.

10492 (DOE/EV/73002—1(Vol.3), pp 18.1-18.38) Wood residue. 1980.

In Alaska Regional Energy Resources Planning Project. Phase 2: coal, hydroelectric and energy alternatives. Volume III. Alaska's alternative energies and regional assessment inventory update.

The history, technology, applicability to Alaska and environmental impact of wood fuels are examined. (MHR)

10493 (DOE/JPL/954355—80-15) Large area silicon sheet by EFG. Annual progress report, October 1, 1979-September 30, 1980. Wald, F.V. (Mobil Tyco Solar Energy Corp., Waltham, MA (USA)). 2 Feb 1981. Contract NAS-7-100-954355. 94p. NTIS, PC A05/MF A01.

Progress in the development of a cartridge system for growth of 10 cm wide ribbon is described. Growth speed capability, automated growth, ribbon quality and solar cell performance are areas in which significant progress is reported. Routine growth of 10 cm wide ribbon at speeds in the range from 3.5 to 4.0 cm/minute has been demonstrated both in single cartridge and multiple ribbon furnaces. Simultaneous growth of three 10 cm wide ribbons over a period of several hours has also been accomplished. A system for automated control of ribbon width has been developed and successfully implemented in the multiple ribbon growth system. As-grown ribbon quality and solar cell performance has continued to improve for the 10 cm wide ribbon grown in high-speed systems. Cell efficiencies of greater than 10% have been demonstrated on large areas ($\sim$ 50 cm^2) of this ribbon. Better optimized growth conditions and cell processing have now been combined to produce greater than 13% (AMl) small area ($\sim$ 6 cm^2) cells on ribbon grown at 2 cm/minute. Optimization work for 10 cm wide ribbon is continuing aimed at understanding the factors which affect quality in these systems. Utilization of computer modeling to study interface shapes and mass transport phenomena in the meniscus are described.

10494 (DOE/JPL/954356—80/14) Silicon-on-ceramic process: silicon sheet growth and device development for the large-area silicon sheet task of the Low-Cost Solar Array Project. Annual report No. 5, September 29, 1979-September 30, 1980. Whitehead, A.B.; Zook, J.D.; Grung, B.L.; Heaps, J.D.; Schmit, F.; Schuldt, S.B.; Chapman, P.W. (Honeywell Corporate Material Sciences Center, Bloomington, MN (USA)). 5 Jan 1981. Contract NAS-7-100-954356. 82p. NTIS, PC A05/MF A01.

The objective of this research is to investigate the technical feasibility of producing solar-cell-quality sheet silicon to meet the DOE 1986 cost goal of 70 cents/watt. The silicon-on-ceramic approach is to coat a low-cost ceramic substrate with large-grain polycrystalline silicon by unidirectional solidification of molten silicon. Results are reported. A new silicon-coating system, SCIM-II, was designed and constructed. A design strategy to avoid buckling and breaking of substrates has been formulated, implemented, and verified. Detailed thermal modeling of the heating and cooling zones has been performed, and the results have been compared with experiment. A number of modifications have been made in SCIM-II to implement the strategy to minimize thermal stress and to improve reproducibility of coating conditions. Dip-coating has been continued in order to supply material for cell fabrication, since impure carbon parts have been used in the SCIM-coater while changes were still being made. The best cell had a total-area efficiency of 10.5% (AM1, AR) for a cell area of 5 cm^2. The highest

efficiencies were produced with a PH_3 diffusion at 850°C, followed by a slow cooldown at about 5°C/min. Theoretical modeling of SOC solar cells shows that present cell performance is limited by diffusion length, and that 13% SOC cells are possible with a diffusion length of 50 μm. The average diffusion length in SOC material is 15 to 25 μm. Cost estimates of the SOC process are $13/m² added value, or $17.25/m² including silicon at $14/kg. Based on 11% module efficiency, this corresponds to a sheet cost of 16.6 cents/W/sub p/. (WHK)

10495 **(DOE/JPL/954527—80/16) Investigation of test methods, material properties, and processes for solar cell encapsulants. Seventeenth quarterly progress report, May 12-August 12, 1980.** Willis, P.B.; Baum, B. (Springborn Labs., Inc., Enfield, CT (USA)). Sep 1980. Contract NAS-7-100-954527. 31p. NTIS, PC A03/MF A01.

The goal of this program is to identify, evaluate, and recommend encapsulant materials and processes for the production of cost-effective, long-life solar cell modules. Development efforts have emphasized the reformulation of polybutyl acrylate, a liquid pottant used in the casting encapsulation process. This material has been modified to yield a composition with much faster cure at lower temperatures. Minimodules have been successfully prepared from this low cost compound and are currently being evaluated by thermal/humidity cycling. Differential thermal analysis (DTA) was used for the examination of thermal stability in some of the pottant compounds of current interest. This method was useful in determining the temperatures at which oxidative or pyrolysis reactions resulted in degradation of the polymers. All the candidate pottants showed degradation onsets of over 200°C. The effectiveness of a new primer was determined during this period. This formulation was similar to the silane coupling agent used in past experimentation but was modified with a peroxide to enhance the activity. Excellent bound strengths were obtained to glass, and mild steel that were resistant to immersion in boiling water. EVA to low iron glass gave an average bond strength of 35 lbs per inch of width. This new primer was also evaluated for the corrosion protection that could be provided to metal surfaces when primed and encapsulated in EVA. (WHK)

10496 **(DOE/JPL/954796—80/10) Analysis and evaluation in the production process and equipment area of the Low-Cost Solar Array Project. Quarterly report, January-April 1980.** Wolf, M. (Pennsylvania Univ., Philadelphia (USA). Moore School of Electrical Engineering). Nov 1980. Contract NAS-7-100-954796. 57p. NTIS, PC A04/MF A01.

The analyses of the front metallization design methods and their impacts on solar cell performance, particularly for large area cells, have been continued and completed herein. The influence of line shape on the effective voltage drop, which was treated before for the uniform width lines and the fully tapered lines, has now been generalized to include any taper. The potential merits of an oblique arrangement of the grid lines with respect to the bus lines are investigated. It is found that the arrangement of the grid lines normal to the bus lines gives the best performance. However, the performance penalty for oblique arrangement at relatively small inclination angles against the normal to the bus line is rather small. Also, the ways of optimizing the front metallization pattern, consisting of grid and bus lines, with respect to lowest total performance loss, due both to shading by metal coverage and to voltage drops in the various elements of the current path, was re-investigated. It was determined that it is essential that each level in the hierarchy of conductors have a substantially lower sheet resistance, by at least an order of magnitude, than the preceding level. The findings of these analyses were combined into a set of Design Rules for the front metallization design for large area solar cells. (WHK)

10497 **(DOE/JPL/954929—81/8) Investigation of reliability attributes and accelerated stress factors on terrestrial solar cells. Third annual report.** Lathrop, J.W.; Hartman, R.A.; Saylor, C.R. (Clemson Univ., SC (USA)). Jan 1981. Contract NAS-7-100-954929. 227p. NTIS, PC A11/MF A01.

The third year of the accelerated reliability testing program concentrated on electrical measurement instrumentation and in modeling cell behavior in the second quadrant. In addition, some preliminary work was done on correlating cell color changes with electrical degradation. Not reported are results of continuing accelerated stress tests on state of the art cells. A number of new cells were added to the program, but not in time for sufficient data to be obtained, while the older cells are undergoing extended test periods and new data are not yet available on them. The all-digital, microprocessor controlled, short interval tester, which was designed and fabricated, has replaced the manual measurement procedure formerly used. This has improved measurement accuracy and repeatability, reduced measurement time, and through coordinated data management procedures, eliminated data errors. A complete description of the tester including schematics and software is given and its operating procedures described. A computer model, based on the thermal and electrical properties of the cells and encapsulating materials, was developed to relate cell temperature to electrical characteristics in the second quadrant. This model adequately predicted the behavior of both encapsulated and unencapsulated cells, although accurate temperature measurements on encapsulated cells were difficult to obtain. In addition, only cells of one type were used for comparison and other cell types may require different parameter values for fitting. Use of the model should permit the prediction of a cell's sensitivity to degradation in the second quadrant. The computer program is listed together with a description of its operation.

10498 **(DOE/JPL/955382—80/7) Low-Cost Solar Array Project. Task I. Silicon material: investigation of the hydrogenation of $SiCl_4$. Seventh quarterly report.** Mui, J.Y.P. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemistry). 12 Jan 1981. Contract NAS-7-100-955382. 15p. NTIS, PC A02/MF A01.

Research and development work on the hydrochlorination of $SiCl_4$ and m.g. silicon metal to $SiHCl_3$ is reported. Activities include a series of experiments to study the life of the Si mass bed. The effect of prolonged reaction on the rate of the hydrochlorination reaction was studied, and a material balance on the reaction was made. A corrosion study was made on Incoloy 800 as the selected material of construction for the hydrochlorination reactor in the Union Carbide EPSDU. (WHK)

10499 **(DOE/JPL/955491—81/5) Development of processes for the production of solar grade silicon from halides and alkali metals. Phase II. Fifth quarterly report, 1 October-31 December 1980.** Dickson, C.R.; Felder, W.; Gould, R.K. (AeroChem Research Labs., Inc., Princeton, NJ (USA)). Jan 1981. Contract NAS-7100-955491. 26p. (AeroChem-TN—217). NTIS, PC A03/MF A01.

The objective of the program is to characterize the kinetics and mechanism of the formation and growth of silicon particles from the decomposition of silane at high temperatures. The experiments are aimed at determining the rates at which gas-phase species form silicon particle precursors, the time required for silane decomposition to produce silicon particles, and the competing rate of growth of silicon seed particles injected into a decomposing silane environment. The AeroChem high-temperature fast-flow reactor (HTFFR), modified to study the decomposition of silane and the subsequent growth of particles, was tested and particle growth measurements were made as functions of temperature (600 to 1200°C), pressure (50 to 550 Torr), and residence time (0.5 to 30 ms). Optical diagnostics consisting of attenuation and 90° Mie scattering of the light from He-Ne or Ar^+ lasers were used to determine the appearance growth rates and absolute sizes of the particles. The extent of silane decomposition was measured by infrared absorption spectroscopy. Representative data obtained at 900°C indicate that: (1) particles formed from silane decomposition are spherical in shape and have a narrow size distribution at a given time in the decomposition/growth process; (2) silane disappearance and particle growth are controlled by heterogeneous gas-particle interactions for particles greater than 0.05 μm radius; and (3) tentatively, particles larger than 0.05 μm radius have a cellular structure (from SEM of collected particles). These results led to the formation of a simplistic model for the particle growth process.

10500 **(DOE/JPL/955533—80-4) Development of a polysilicon process based on chemical vapor deposition. Phase 1. Fourth quarterly progress report, 1 July-30 September 1980.** Sharp, K.; Arvidson, A.; Sawyer, D. (Hemlock Semiconductor Corp., MI (USA)). Dec 1980. Contract NAS-7-100-955533. 52p. NTIS, PC A04/MF A01.

The goal of this program is to demonstrate that a dichlorosilane-based reductive chemical vapor deposition (CVD) process is capable of producing, at low cost, high quality polycrystalline silicon for use in the manufacture of high efficiency solar cells. The feasibility of silicon generation from dichlorosilane (DCS) has been well established. The feasibility and optimization portions of the experimental reactor program have been completed, with a number of runs having been conducted over a broad range of conditions in an experimental CVD reactor. Activities relating to feed of commercially purchased DCS to an intermediate sized reactor and to construction of a Process Development Unit (PDU) to generate and feed DCS to one or more production scale reactors were suspended during the previous quarter because of the receipt of new safety-related information about DCS from Hazards Research Corp. Experimental data generated by Hazards Research Corp. indicate that DCS/air mixtures possess about four times the explosive severity potential as hydrogen/air mixtures, and that DCS/air mixtures are very readily ignited. As a consequence of this new information, designs and procedures for the intermediate reactor feed and PDU tasks were deemed inadequate and new designs incorporating new safety-related elements are being formulated. A preliminary economic evaluation of the Hemlock Semiconductor process has been completed. The analysis for a plant to generate 1000 metric tonne of silicon indicates a plant investment of $21.9 M, and a product selling price of $19.85/kg.

10501 **(DOE/JPL/955725—81/2) High resolution, low cost solar cell contact development. Quarterly technical progress and schedule report for the period ending December 31, 1980. CDRL 4.** Garcia, A. (Spectrolab, Inc., Sylmar, CA (USA)). 12 Jan 1981. Contract NAS-7-100-955725. 29p. NTIS, PC A03/MF A01.

The scope of the contract covers the development and evaluation of forming solar cell collector grid contacts by the MIDFILM process. This is a proprietary process developed by the Ferro Corporation which is a subcontractor for the program. The MIDFILM process attains line resolution characteristics of photoresist methods with processing related to screen printing. The surface to be processed is first coated with a thin layer of photoresist material. Upon exposure to ultraviolet light through a suitable mask, the resist in the non-pattern area cross-links and becomes hard. The unexposed pattern areas remain tacky. The conductor material is applied in the form of a dry mixture of metal and frit particles which adher to the tacky pattern area. The assemblage is then fired to ash the photo-polymer and sinter the fritted conductor powder. Progress is reported. (WHK)

10502 **(DOE/R4/10075—T1(Vol.2)) Fuel ethanol and South Carolina: a feasibility assessment. Volume II. Detailed report.** (South Carolina State Government, Columbia (USA)). Jul 1980. Contract FG44-80R410075. 252p. NTIS, PC A12/MF A01.

The feasibility of producing ethanol from carbohydrates in the State of South Carolina is discussed. It is preliminary in the sense that it provides partial answers to some of the questions that exist concerning ethanol production in the state, and is not intended to be a comprehensive treatment of the subject. A great deal more work needs to be done as ethanol fuels become a more significant element in South Carolina's energy mix. The existing carbohydrate resource base in the state is reviewed, the extent to which this base can be increased is estimated, and importation of out-of-state feedstocks to expand the base further is discussed. A discussion of the economics of ethanol production is provided for farm-scale and commercial-sized plants, as is a general discussion of environmental impacts and state permitting and approval requirements. Several other considerations affecting the small-scale producer are addressed, including the use of agricultural residues and manure-derived methane to fuel the ethanol production process. Research needs are identified, and brief case studies for Williamsburg and Orangeburg counties are provided.

10503 **(DOE/SF/10550—T1) Feasibility of using Russian thistle Salsola kali L. for bioconversion. Fifth quarterly report, 1 August-31 October 1980.** Karpiscak, M.M.; Rawles, R.L.; Foster, K.E. (Arizona Univ., Tucson (USA). Office of Arid Lands Studies). Nov 1980. Contract FG03-79SF10550. 13p. NTIS, PC A02/MF A01.

Studies of seed viability, germination and plant growth for Russian thistle (tumbleweed) are described. (MHR)

10504 **(DOE/SF/10550—T2) Feasibility of using Russian thistle Salsola kali L. for bioconversion. Third quarterly report, 1 February-30 April 1980.** Karpiscak, M.M.; Rawles, R.L.; Foster, K.E. (Arizona Univ., Tucson (USA). Office of Arid Lands Studies). May 1980. Contract FG03-79SF10550. 37p. NTIS, PC A03/MF A01.

One progress report and one topical report are included. A separate abstract was prepared for each one. (MHR)

10505 (DOE/SF/10550—T2, pp 1-11) **Feasibility of using Russian thistle Salsola kali L. for bioconversion.** May 1980.

In Feasibility of using Russian thistle Salsola kali L. for bioconversion. Third quarterly report, 1 February-30 April 1980.

Tumbleweed seed viability and germination are under study. Tumblelogs were modified by the addition of approximately 15% ground jojoba meal or 20% ground pecan hulls. The ash content was determined by weight and volume. Estimates of Russian thistle production and processing costs are included. (MHR)

10506 (DOE/SF/10550—T2, pp 13-18) **Utilization of field-matured tumbleweed.** Meinel, A.B.; Meinel, M.P. May 1980.

In Feasibility of using Russian thistle Salsola kali L. for bioconversion. Third quarterly report, 1 February-30 April 1980.

Some characteristics of field-matured tumbleweeds are reviewed. The cases of fallow field and deliberately cultivated stands, along with natural wind concentration along fence lines or in situ harvesting, are considered. A recommendation is made to improvise experimental production of dry harvested tumbleweeds into logs.

10507 **(DOE/SF/10550—T3) Feasibility of using Russian thistle Salsola kali L. for bioconversion. Fourth quarterly report, 1 May-31 July 1980.** Karpiscak, M.M.; Rawles, R.L.; Foster, K.E.; Meinel, A.B.; Meinel, M.P. (Arizona Univ., Tucson (USA)). Aug 1980. Contract FG03-79SF10550. 16p. NTIS, PC A02/MF A01.

Seeds from tumbleweed plants were collected and experimental plantings initiated. Compaction evaluation of cubed Russian thistle was conducted and it was concluded that a 50% binder by weight would produce a good burning log. Russian thistle production costs are summarized. (MHR)

10508 **(DOE/SF/10550—T4) Feasibility of using Russian thistle Salsola kali L. for bioconversion. Quarterly report, 1 August 1979-31 October 1979.** Karpiscak, M.M.; Rawles, R.L.; Foster, K.E. (Arizona Univ., Tucson (USA). Office of Arid Lands Studies). Nov 1979. Contract FG03-79SF10550. 21p. NTIS, PC A02/MF A01.

Two acres of tumbleweed have been selected as potential seed plants for use in cultivation studies. Natural stands have been baled and cubed using commercially available alfalfa harvesting machinery. Two samples were examined to determine their potential as sources of high-energy extractables. (MHR)

10509 **(DOE/SF/10550—T5) Feasibility of using Russian thistle Salsola kali L. for bioconversion. Second quarterly report, 1 November-31 January 1980.** Karpiscak, M.M.; Rawles, R.L.; Foster, K.E. (Arizona Univ., Tucson (USA). Office of Arid Lands Studies). Feb 1980. Contract FG03-79SF10550. 26p. NTIS, PC A03/MF A01.

The Russian thistle (tumbleweed) seed harvesting and species diversity are described. The baled and cubed Russian thistle was ground and processed into artificial fireplace logs. (MHR)

10510 **(DP-MS—80-116) Environmental effects of producing biomass in pine and hardwood plantation for renewable energy resources.** Hollod, G.H.; Corey, J.C.; Dyer, E.F. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 18p. (CONF-801171—2). NTIS, PC A02/MF A01.

From 7. national conference on energy and the environment; Phoenix, AZ, USA (30 Nov 1980).

Conversion of woody biomass into useable energy forms has stimulated interest in increasing biomass production to help meet the nation's energy needs. However, maximizing biomass production may be limited by the decrease in fertility of soils. The environmental effects of applying sewage sludge to maximize forest production is being studied at the Department of Energy's Savannah River Plant.

10511 **(HEDL-TC—1879) Development status of the electro-thermal and spatial spectral scanning system for solar cells.** Green, D.R.; Olsen, L.C.; Price, L.S.; Sheen, E.M. (Hanford Engineering Development Lab., Richland, WA (USA)). Dec 1980. Contract AC14-76FF02170. 20p. NTIS, PC A02/MF A01.

Electro-thermal infrared scanning is a new method for detecting local differences in diode parameters. This method uses an infrared scanner to map small increases in local surface temperatures of a diode after applying a bias voltage. The feasibility of this method has been demonstrated for diodes reverse biased beyond the breakdown voltage. An electro-thermal solar cell scanning system is being developed which should have high enough sensitivity to detect local differences within diodes biased at voltages more positive than the reverse breakdown. This system, applied to solar diodes over their entire range of operation, is expected to be a powerful tool for use in developing solar cells and possibly for correcting some types of production line difficulties. A second new method, the spatial spectral scanner, is also being incorporated in the electro-thermal system to give further information on spatial variations within solar cells. This method scans the solar cell with a minute spot of variable frequency light while the cell's output current is recorded, ad will augment information from the electro-thermal system. (MHR)

10512 **(IS—4759) Photoelectrochemical solar cells based on d-band electrochemistry at transition metal diselenides. Final technical progress report, year one.** Parkinson, B.A. (Ames Lab., IA (USA)). Oct 1980. Contract W-7405-ENG-82. 35p. NTIS, PC A03/MF A01.

The work with tungsten diselenide and molybdenum diselenide can be divided into two major directions. The first direction is the growth of high quality single crystals of the materials to establish the practical maximum solar energy conversion efficiency of layered compounds. The second effort uutilizes less perfect single crystals with edge sites exposed as models of a polycrystalline device with the goal of understanding the mechanism by which recombination limits the efficiency of these materials and to devise methods for reducing the recombination. Progress is reported.

10513 **(LBL—11489(Rev.)) Economics of sugar production with Trichoderma reesei Rutgers C-30.** Perez, J.; Wilke, C.R.; Blanch, H.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., Berkeley (USA). Dept. of Chemical Engineering). Aug 1980. Contract W-7405-ENG-48. 25p. (CONF-800814—31(Rev.)). NTIS, PC A02/MF A01.

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; Las Vegas, NV, USA (24 Aug 1980).

The economics of sugar production from bioconversion of corn stover utilizing cellulase obtained from Trichoderma reesei strain Rutgers C-30 were investigated. The cost of manufacturing sugar is 10.5 cents per pound. This reduced cost is due to cellulase activities ranging from 7 to 14 IU/ml from batch cultures. Hydrolysis can be carried out at substrate concentrations up to 25% and give product streams containing up to 9% sugars. Conversions up to 61% of theoretical have been observed. A sensitivity analysis indicates that sugar can be produced at near competitive prices from corn stover costing $0 to $50 per ton. By utilizing new fermentation technology, sugar at these prices can be used to product 95% alcohol at a cost ranging from $1.80 to $3.00 per gallon.

10514 **(NP—25237) Testing biomass prediction equations with conventional cruise and whole tree harvesting techniques.** Curtin, D.T.; Brooks, R.T. Jr.; Rennie, J.C. (Tennessee Valley Authority, Norris (USA)). Sep 1980. 25p. NTIS, PC A02/MF A01.

This study evaluated the use of conventional plot cruising techniques and biomass regression equations to estimate biomass per acre and biomass per tree. Based on thirty 1/20-acre plots, stand biomass (trees 5 inches d.b.h. and larger) was estimated to be 116.9 tons per acre, with 95 percent confidence limits from 99.7 to 134.2 tons per acre. The stand biomass, determined by harvesting with a whole tree harvesting system, was 100.4 tons per acre. Estimated mean tree weight was 0.5143 ton with 95 percent confidence limits from 0.4171 to 0.6115. Mean tree weight for the population was 0.6048 ton. Both confidence limits include the population value being estimated. However, each population value is near the end of its confidence interval, which may be due in part to a number of small trees not being processed in the harvesting operation. Although the precision of this sample was acceptable (a confidence interval of 15 percent of the mean stand biomass), a sampling intensity of a least 5 percent might be considered.

10515 **(PNL—3695(App.C)) Investigations on catalyzed steam gasification of biomass: feasibility study of methane production via catalytic gasification of 200 tons of wood per day.** Mudge, L.K.; Weber, S.L.; Mitchell, D.H.; Sealock, L.J. Jr.; Robertus, R.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1981. Contract AC06-76RL01830. 76p. NTIS, PC A05/MF A01.

This report is a result of an additional study made of the economic feasibility of producing substitute natural gas (SNG) from wood via catalytic gasification with steam. The report has as its basis the original 2000 tons of wood per day study generated from process development unit testing performed by the Pacific Northwest Laboratory. The goal of this additional work was to determine the feasibility of a smaller scale plant one-tenth the size of the original or 200 tons of dry wood feed per day. Plant production based on this wood feed is 2.16 MM Scfd of SNG with a HHV of 956 Btu per Scf. All process and support facilities necessary to convert wood to SNG are included in this study. The plant location is Newport, Oregon. The capital cost for the plant is $26,680,000 - September 1980 basis. Gas production costs which allow for return on capital have been calculated for various wood prices for both utility and private investor financing. These wood prices represent the cost of unchipped wood delivered to the plant site. For utility financing, the gas production costs are, respectively, $14.34, $14.83, $15.86, and $17.84 per MM Btu for wood costs of $5, $10, $20, and $40 per dry ton. For private investor financing, the corresponding product costs are $18.76, $19.26, $20.28, and $22.31 per MM Btu for the corresponding wood costs. The costs calculated by the utility financing method includes a return on equity of 15% and an interest rate of 10% on the debt. The private investor financing method, which is 100% equity financing, incorporates a discounted cash flow (DCF) return on equity of 12%. The thermal efficiency without taking an energy credit for char is 57.4%.

10516 **(PNL—3695(App.D)) Investigations on catalyzed steam gasification of biomass: feasibility study of methanol production via catalytic gasification of 200 tons of wood per day.** Mudge, L.K.; Weber, S.L.; Mitchell, D.H.; Sealock, L.J. Jr.; Robertus, R.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1981. Contract AC06-76RL01830. 73p. NTIS, PC A04/MF A01.

This report is a result of an additional study made of the economic feasibility of producing fuel grade methanol from wood via catalytic gasification with steam. The report has as its basis the original 2000 tons of wood per day study generated from process development unit testing performed by the Pacific Northwest Laboratory (PNL). The goal of this additional work was to determine the feasibility of a smaller scale plant one tenth the size of the original or 200 tons of dry wood feed per day. Plant production based on this wood feed is 100 tons per day of methanol with a HHV of 9784 Btu per pound. All process and support facilities necessary to

convert wood to methanol are included in this study. The plant location is Newport, Oregon. The capital cost for the plant is $34,830,000 - September 1980 basis. Methanol production costs which allow for return on capital have been calculated for various wood prices for both utility and private investor financing. These wood costs include delivery to the plant. For utility financing, the methanol production costs are, respectively, $1.20, $1.23, $1.30, and $1.44 per gallon for wood costs of $5, $10, $20, and $40 per dry ton. For private investor financing, the corresponding product costs are $1.60, $1.63, $1.70, and $1.84 per gallon for the corresponding wood costs. The costs calculated by the utility financing method include a return on equity of 15% and an interest rate of 10% on the debt. The private investor financing method, which is 100% equity financing, incorporates a discounted cash flow (DCF) return on equity of 12%. The thermal efficiency of the plant is 52.0%.

10517 (SAN—1202-8) Thin films of gallium arsenide on low-cost substrates. Final technical report, July 5, 1976-December 5, 1978. Ruth, R.P.; Dapkus, P.D.; Dupuis, R.D.; Johnson, R.E.; Moudy, L.A.; Yang, J.J.; Yingling, R.D. (Rockwell International Corp., Anaheim, CA (USA). Electronic Devices Div.). Mar 1980. Contract AC03-76ET20435. 104p. NTIS, PC A06/MF A01.

The MO-CVD technique was applied to the growth of thin films of GaAs and GaAl As on inexpensive polycrystalline or amorphous substrate materials (primarily glasses and metals) for use in fabrication of large-area low-cost photovoltaic device structures. Trimethylgallium, arsine, and trimethylaluminum are mixed in appropriate concentrations at room temperature in the gaseous state and pyrolyzed at the substrate, which is heated in a vertical reactor chamber to temperatures of 700 to 750°C, to produce the desired film composition and properties. Studies of the properties of grain boundaries in polycrystalline GaAs films by the use of transport measurements as a function of temperature indicated that the grain boundary regions are depleted of majority carriers by a large density of neutral traps at the grain boundary interface, causing a barrier to majority carrier flow in the material. Schottky-barrier solar cells of ~ 3 percent efficiency (simulated AM0 illumination, no AR coating) were demonstrated on thin-film polycrystalline GaAs n/n^+ structures on Mo sheet, Mo film/glass, and graphite substrates. Substantial enhancement of average grain size in polycrystalline MO-CVD GaAs films on Mo sheet was obtained by the addition of HCl to the growth atmosphere during deposition. Extensive investigation of polycrystalline thin-film p-n junctions indicated that the forward voltage of such devices is apparently limited to 0.5 to 0.6V. A laboratory-type deposition apparatus for the formation of TiO_2 antireflection (AR) coatings by pyrolysis of titanium isopropoxide was assembled and tested. Detailed analyses were made of the materials and labor costs involved in the laboratory-scale fabrication of MO-CVD thin-film GaAs solar cells. Details are presented. (WHK)

10518 (SAN—1250/3) Research on lattice-mismatched semiconductor layers. Annual technical report No. 3, May 15, 1978-July 15, 1979. Cooper, C.B. III.; Moon, R.L. (Varian Associates, Inc., Palo Alto, CA (USA)). Sep 1979. Contract AC03-76ER01250. 29p. NTIS, PC A03/MF A01.

The performance of GaAsSb diodes is shown to degrade rapidly when the dislocation density introduced by mismatch dislocation exceeds $10^6 cm^{-2}$. The performance can be restored by reducing the dislocation density by step grading the composition to the same total mismatch. Methods for additional improvements in the grading step are discussed. It is shown that with organometallic VPE, using TMSb, GaAsSb can be grown to compositions of at least 12% Sb. However, incorporation of Sb decreases rapidly as the substrate temperature is increased. If the TMSb concentration in the gas phase is increased above a certain value in an attempt to increase Sb incorporation, needle-like defects grow on the surface. Other growth conditions are now being tried. In addition to GaAsSb, AlGaAs was grown on GaP as an alternative to the AlGaAsSb stacked-cell structure. Preliminary tests on the synthesis of new p-type dopants for AlGaAs were undertaken. A magnesium compound has been synthesized, which if Mg behaves as it does in LPE material, should incorporate to a larger degree than Zn.

10519 (SAND—79-7055/2) Photovoltaic concentrator array production process study. Volume II. Study results. Final report. Hodge, R.C. (General Electric Co., Philadelphia, PA (USA). Valley Forge Space Center). Jan 1981. Contract AC04-76DP00789. 198p. NTIS, PC A09/MF A01.

Photovoltaic concentrator array designs were evaluated in terms of their low production and life cycle cost analysis. Salient program design guidelines were defined which established the basic performance assumptions, environmental issues and design trade-off variables. Available design detail was then compiled. Preliminary manufacturing costs were estimated for each of the array concepts. Using energy costs, and assessments as to each array's technology readiness and improvement potential, the various arrays were ranked. The most promising arrays selected for the more detailed design optimization and cost studies were the point focus Fresnels, linear Fresnels, and one-axis troughs. Each of the selected array designs was analyzed to find ways to consolidate parts, and reduce material and assembly labor content. Drawing packages to include parts lists were prepared for each of the optimized array designs. Vendor quotes were obtained for all components deemed commercially available. Manufacturing processes were conceptualized for 10^4, 10^5 and $10^6 m^2/yr$ production rates for all components not commercially available (except the solar cells). Corresponding cycle times, equipment, tooling, and labor requirements were defined. Material quantities and costs were quantified, and resultant direct manufacturing costs were calculated. A survey was performed of existing sell price markup methodologies, and the calculated sell price factor was used to calculate array sell prices. Corresponding shipping, installation, operation and maintenance costs were estimated. Levelized energy costs were then calculated. Results from the study were analyzed and conclusions and recommendations presented. (WHK)

10520 (SAND—80-2373) Photovoltaic concentrator technology development project. Sixth project integration meeting. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1980. Contract AC04-76DP00789. 306p. (CONF-801151—). NTIS, PC A14/MF A01.

From 6. photovoltaic concentrator technology development project intergration meeting; Albuquerque, NM, USA (5 Nov 1980).

Thirty-three abstracts and short papers are presented which describe the current status of research, development, and demonstration of concentrator solar cell technology. Solar concentrators discussed include the parabolic trough, linear focus Fresnel lens, point focus Fresnel lens, and the parabolic dish. Solar cells studied include silicon, GaAs, and AlGaAs. Research on multiple junction cells, combined photovoltaic/thermal collectors, back contact solar cells, and beam splitter modules is described. Concentrator solar cell demonstration programs are reported. Contractor status summaries are given for 33 US DOE concentrator solar cell contracts; a description of the project, project status, and key results to date is included. (WHK)

10521 (SERI/PR—0-8254-F) Amorphous thin films for solar-cell applications. Final report, 11 September 1979-10 September 1980. Carlson, D.E.; Crandall, R.S.; Dresner, J.; Goldstein, B.; Hanak, J.J.; Moore, A.R.; Schade, H.E.; Staebler, D.L.; Weakliem, H.A. (RCA Labs., Princeton, NJ (USA)). Oct 1980. Contract AC02-77CH00178. 92p. NTIS, PC A05/MF A01.

The drift mobility has been measured in doped amorphous silicon by measuring the current transient in a Schottky-barrier device during a reverse-bias voltage pulse. The drift mobility is approx. 6.5×10^{-3} $cm^2/V\text{-}s$ at room temperature. Mass spectroscopy studies indicate that the film growth cannot be a simple ion-surface recombination process but is probably due to either thermal decomposition of higher silanes or free radical-surface reaction. The photoelectromagnetic effect has been used to measure the hole diffusion length in undoped a-Si:H. Another technique that has been recently developed at RCA involves surface photovoltage profiling of solar-cell structures. This technique involves the use of a vibrating probe in conjunction with an argon sputtering beam to probe the field distribution of p-i-n cells. Preliminary measurements of the Hall effect in p-type a-Si:H yield a value of approx. 2×10^{-2} $cm^2/V\text{-}s$ at 100°C with an activation energy of 0.45 eV. Electron irra-

diation studies show that the threshold energy for electron bombardment damage is more than 10^2X less than in crystalline Si. A detailed study of the effects of adding various fluorine-containing gases (SiF_4, HF and F_2) to silane discharges showed that the device performance is adversely affected. A detailed description of an experimental optimization technique for both a-Si:H materials and solar cells is given. This technique utilizes samples made with graded deposition conditions and characterized with automated testing equipment. These procedures have helped to develop two different types of p-i-n solar cells with conversion efficiencies in the 5 to 6% range. It was shown that interference fringes in the collection efficiency of a-Si:H solar cells can give useful information concerning the transport in gap states.

10522 **(SERI/PR—8104-2-T4) Commercialization of a thick-film solar cell. Quarterly technical progress report, October 1-December 31, 1980.** McDonald, G.D. (Johnson Controls, Inc., Milwaukee, WI (USA)). 1980. Contract AC02-77CH00178. 18p. NTIS, PC A02/MF A01.

The objective of this program is to evaluate the use of screen printing as a technique for producing large area solar cells. The work presented deals primarily with the preparation and improvement in performance of screen printed CdS cells. Thermal gravimetric analysis of the CdS inks used to print CdS films confirm that all the fugitive binders and flux are removed under firing conditions used to prepare the CdS films. Warpage of the Nesatron glass substrates makes their use questionable. Multiple layers of CdS appear to resolve a pin hole problem previously encountered. (WHK)

10523 **Long-term meter-recorder for solar cell output power.** Kawano, A.; Tachizawa, H. (to Nippon Electric Co Ltd (Japan)). US Patent 4,222,665. 16 Sep 1980. vp.

A low power consumption solar cell meter-recorder capable of measuring the output power of a solar cell and recording the measured data and the date of measurement, all at a remote location using only battery power, is disclosed. The voltage output of the solar cell is converted into a frequency which is counted over a predetermined time to produce the measured data. The measured data is stored in a first address section of a memory. Digital date information is generated and stored in a second address section of the memory. Both the first and the second address sections are addressed by the same address number. When a read out is desired, the measured data and date stored in the memory are displayed.

10524 **Sun-tracking solar energy conversion system.** Moeller, D.E. (to Sun Trac Corp). US Patent 4,223,174. 16 Sep 1980. Filed date 19 Jul 1976. vp.

A number of solar energy converter assemblies are carried by a support frame which is mounted for independent rotation about a horizontal and a vertical axis. Sensors detect the position of the sun; and control circuitry positions the support frame in elevation and azimuth so that the converter assemblies track and face the sun whenever the sun incident energy is greater than a threshold level of about 25 percent of normal. Each converter assembly includes a solar cell and a multiangular conical concentrator shell for collecting, concentrating and directing incident solar energy onto the solar cell. The converter assemblies, the support frame and its mount, and the drive mechanism for the support frame are all located within a transparent stationary housing or enclosure, which provides complete environmental protection for all elements mounted within the enclosure.

10525 **Method and apparatus for fabricating improved solar cell modules.** Bloch, J.T.; Hanger, R.T.; Nichols, F.W. (to U S of America NASA Administrator Of). US Patent 4,219,926. 2 Sep 1980. Filed date 23 Feb 1979. vp.

The invention is embodied in a method and apparatus for fabricating an improved solar cell module. The apparatus includes a supply drum for feeding a flexible strip having deposited thereon etched electrical circuitry, a supply drum for feeding into overlying engagement with the flexible strip a flexible tape having a pair of exposed tacky surfaces, and a plurality of rams for receiving and depositing a plurality of solar cells in sideby-side relation on an exposed tacky surface of the tape in electrical contacting engagement with the etched circuitry.

10526 **(DOE/R4/10075—T1(Vol.1)(Exec.Summ.)) Fuel ethanol and South Carolina: a feasibility assessment. Volume I. Executive summary.** (South Carolina State Government, Columbia (USA)). Jul 1980. Contract FG44-80R410075. 37p. NTIS, PC A03/MF A01.

The feasibility of producing ethanol from carbohydrates in the State of South Carolina is discussed. It is preliminary in the sense that it provides partial answers to some of the questions that exist concerning ethanol production in the state, and is not intended to be a comprehensive treatment of the subject. A great deal more work needs to be done as ethanol fuels become a more significant element in South Carolina's energy mix. The existing carbohydrate resource base in the state is reviewed. the extent to which this base can be increased is estimated, and importation of out-of-state feedstocks to expand the base further is discussed. A discussion of the economics of ethanol production is provided for farm-scale and commercial-sized plants, as is a general discussion of environmental impacts and state permitting and approval requirements. Several other considerations affecting the small-scale producer are addressed, including the use of agricultural residues and manure-derived methane to fuel the ethanol production process. Finally, research needs are identified.

10527 **Laser processing of materials.** Narayan, J. (Oak Ridge Natl Lab, Tenn). *Journal of Metals ;* **32**: No. 6, 15-21(Jun 1980).

This article summarizes the annealing of displacement damage in ion-implanted semiconductors to make superior p-n junctions and solar cells; removal of dislocation loops and precipitates to improve thermally diffused junctions; laser-induced diffusion to form p-n junctions in semiconductors deposited (instead of implanted or thermally diffused) with dopants; and fundamental studies on growth of dislocations, cell formation and alloying. Other areas in the field of metals are covered briefly. 23 refs.

10528 **Reactive plasma process for forming metal grid patterns in solar cell antireflection coatings.** Sparks, T.G.; Pryor, R.A. (Motorola Inc, Phoenix, Ariz). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference ;* No. 80CH1508-1), 783-786(1980).

The use of a solar cell antireflection (AR) coating, such as silicon nitride, as a metal plating mask provides a synergistic and cost effective means for forming metal contacts by a selective plating process. By using a mechanical mask, a plasma (dry) etching process can be used to etch an ohmic contact grid into the silicon nitride AR film. This eliminates the need for (and expense of) applying and removing disposable resists. Operating in the ion-enhanced plasma etching mode, a fine line plating pattern was etched without contacting the cell surface. The simultaneous etching of front and back contact patterns is demonstrated. 2 refs.

10529 **Improved lamination technique for solar arrays.** Garcia, A. III; Olson, C. (Spectrolab Inc, Sylmar, Calif). *Conference Record of the IEEE (Institute of Electrical ana Electronics Engineers) Photovoltaic Specialists Conference ,* No. 80CH1508-1), 962-964(1980).

Encapsulating solar cells by lamination has been plaguec with problems such as bubbles, cell shifting, ripples, and cracked cells. A low-cost laminating procedure has been developed using a double vacuum bagging technique and recently improved formulations of ethylene vinyl acetate, successfully minimizing these problems. The lamination fixturing used is described. The causes and cures of various problems are discussed and solutions to these problems presented.

10530 **Progress in the growth of wide silicon ribbons by the EFG technique at high speed using multiple growth stations.** Kalejs, J.P.; Mackintosh, B.H.; Sachs, E.M.; Wald, F.V. (Mobil Tyco Sol Energy Corp, Waltham, Mass). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference ;* No. 80CH1508-1, 13-18(1980). (CONF-800106—).

Progress in a program designed to examine the feasibility of large scale production of low-cost silicon sheet substrates for solar cells by the EFG process is reported. A multiple-ribbon EFG sta-

tion, containing five single-ribbon cartridges, has been continuously operated for a period of 15 hours at a duty cycle of 94%. The average width of the ribbon grown was 5 cm, and the average growth speed was 3.4 cm/min. The cartridge concept of ribbon growth has been extended to successfully grow 10 cm wide ribbon at speeds up to 4 cm/min. Large area (approximately 50 cm^2) solar cells with efficiencies in the range from 8% to 11% (AM1) have been made from ribbon grown in the cartridge systems. 9 refs.

10531 Development of processes for the production of low cost silicon dendritic web for solar cells. Duncan, C.S.; Seidensticker, R.G.; McHugh, J.P.; Hopkins, R.H.; Skutch, M.E.; Driggers, J.M.; Hill, F.E. (Westinghouse Electr Corp, Pittsburgh, Pa). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference ;* No. 80CH1508-1, 25-30(1980). (CONF-800106—).

Computer aided furnace design has been used to achieve silicon dendritic web output rates as high as 27 cm^2/min a value in excess of that projected to meet a $0.50 per peak watt solar array manufacturing cost. The feasibility of simultaneous web growth while the melt is replenished with pelletized silicon was also demonstrated. This step is an important precursor to the development of an automated growth system. Solar cells made on the replenished material were just as efficient as devices fabricated on typical webs grown without replenishment. Moreover, web cells made on a less-refined, pelletized polycrystalline silicon synthesized by the Battelle process yielded efficiencies up to 13% (AM1). 10 refs.

10532 Silicon sheet casting experiment. Bickler, D.B.; Sanchez, L.E.; Sampson, W.J. (Calif Inst of Technol, JPL, Pasadena). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference ;* No. 80CH1508-1, 36-38(1980). (CONF-800106—).

The casting of silicon blanks for solar cells directly without slicing is an exciting concept. An experiment was performed to investigate the feasibility of developing a machine that casts wafers directly. A Czochralski furnace was modified to accept a graphite ingot-simulating fixture. Silicon was melted in the middle of the ingot simulator in a boron nitride mold. Sample castings showed reasonable crystal size. Solar cells were made from the cast blanks. The performance is reported. 3 refs.

10533 Continuous coating of silicon-on-ceramic. Heaps, J.D.; Schuldt, S.B.; Grung, B.L.; Zook, J.D.; Butter, C.D. (Honeywell Inc, Bloomington, Minn). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference ;* No. 80CH1508-1, 39-48(1980). (CONF-800106—).

Growth of sheet silicon on low-cost substrates has been demonstrated by the "silicon coating with inverted meniscus" (SCIM) technique. A mullite-based ceramic substrate is coated with carbon and then passed over a trough of molten silicon with a raised meniscus. Solidification occurs at the trailing edge of the downstream meniscus, producing a silicon-on-ceramic (SOC) layer. Meniscus shape and stability are controlled by varying the level of molten silicon in a reservoir connected to the trough. Solar cells made from dip-coated SOC material have demonstrated efficiencies of 10% on 4 cm^2 cells and 9.9% on 10 cm^2 cells. 15 refs.

10534 Behavior of interdigitated back-contact solar cells. Cheng, L.J.; Leung, D.C. (Calif Inst of Technol, JPL, Pasadena). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference ;* No. 80CH1508-1, 72-75(1980). (CONF-800106—).

Experimental data are presented concerning operation mechanisms of two versions of interdigitated back-contact solar cells: the tandem junction cell and the front-surface field cell. It is shown that a photogenerated forward bias at the front junction of a tandem junction cell is a critical parameter for cell performance which not only causes photogenerated carriers to migrate to the back junction, but also eliminates the reduction in photoresponse over back p^+ metallization regions. However, no similar light effects are observed in the performance of front-surface field cells. Finally, a discussion on mechanisms concerning the performance of front-surface field and tandem junction cells along with their merits is given. 6 refs.

10535 Solar cells from ion-implanted, laser-annealed cast polycrystalline silicon. Young, R.T.; Wood, R.F. (Oak Ridge Natl Lab, Tenn). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference ;* No. 80CH1508-1, 214-217(1980). (CONF-800106—).

Solar cells from cast polycrystalline Si have been fabricated by ion implantation followed by pulsed laser annealing. The resulting cell exhibited near-ideal I-V characteristics in the practical operating range with an open circuit voltage of 566 mV fill factor of 0.76 and AM1 efficiency of 12.1%. Spectral response measurements performed on these cells indicate that the blue response is as good as single crystal control cell. All these results indicate that grain-boundary effect is not a serious problem in ion-implanted, laser-annealed cast polycrystalline Si solar cells. 8 refs.

10536 Chemical and structural defects in thin film polycrystalline silicon solar cells. Chu, T.L.; Stokes, E.D.; Chu, S.S.; Abderrassoul, R. (South Methodist Univ, Dallas, Tex). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference ;* No. 80CH1508-1, 224-227(1980). (CONF-800106—).

The deposition of a silicon film containing a p-n junction on a partially purified and recrystallized metallurgical silicon substrate is a promising approach to the fabrication of low cost solar cells. This type of solar cell contains a high concentration of chemical impurities, such as iron, and structural defects, such as grain boundaries. The heat treatment of solar cell structures after the deposition of the active region has been found to be essential for obtaining solar cells of relative high conversion efficiencies. The effects of heat treatment on the photoresponse at defects, investigated by laser scan, steady state surface photovoltage, and EBIC techniques, are discussed. 2 refs.

10537 Overview of thin-film polycrystalline silicon research and development. Kazmerski, L.L. (Sol Energy Res Inst, Golden, Colo). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference ;* No. 80CH1508-1, 281-286(1980). (CONF-800106—).

The status and development of the thin-film polycrystalline silicon solar cell are reviewed. The effects of polycrystallinity and thickness upon material and solar cell performance are assessed for the purpose of defining thin film for this semiconductor. The major, existing research problems for this device are discussed, including those relating to material production, growth methodologies, grain boundary passivation, junction formation, contacting, device configurations, technology, scale-up, costing and degradation/reliability. 36 refs.

10538 Overview of amorphous silicon solar-cell development. Carlson, D.E. (RCA, Princeton, NJ). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference ;* No. 80CH1508-1, 291-297(1980). (CONF-800106—).

The history and status of amorphous silicon solar cells are reviewed, and the performance limitations of the material are discussed. The major loss mechanisms that limit the conversion efficiency are considered for several amorphous silicon solar-cell structures. A comparison is made of calculated and observed photovoltaic parameters, and future directions for improving device performance are discussed. 36 refs.

10539 Low cost monocrystalline silicon sheet fabrication for solar cells by advanced ingot technology. Fiegl, G.F.; Bonora, A.C. (Siltec Corp, Menlo Park, Calif). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference ;* No. 80CH1508-1, 303-308(1980). (CONF-800106—).

Monocrystalline silicon sheet produced by the conventional CZ process and standard I.D. slicing technology is meeting high technical standards but is not cost effective for solar cell applications. A discussion is presented of an ingot technology which allows economic production of silicon sheet for solar cell fabrication. The concepts of the continuous liquid feed (CLF) Czochralski furnace and the enhanced I.D. slicing technology are described,

with a presentation of equipment design characteristics. Influence of process variations on material properties is examined, and critical process parameters with cost sensitivities are reviwed. An economic analysis demonstrates cost effectiveness of the advanced ingot technology for solar applications. 4 refs.

10540 **Performance of silicon solar cells fabricated from multiple Czochralski ingots grown by using a single crucible.** Kachare, A.H.; Uno, F.M.; Miyahira, T.; Lane, R.L. (Calif Inst of Technol, JPL, Pasadena). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference ;* No. 80CH1508-1, 327-331(1980). (CONF-800106—).

Multiple silicon ingots of large diameter were grown by using a single crucible and a newly developed sequential melt replenishment Czochralski (CZO) growth technique. The impurity analysis data for the feedstck and each ingot were obtained by spark source mass spectrometry (SSMS), neutron activation analysis (NAA) or a combination of these methods. Several solar cells were fabricated on wafers from the seed, center and tang end of each ingot to evaluate the growth reproducibility and material quality. The cell efficiency within a given wafer varied by no more than = +5% of the average value. The results show no significant anisotropy for cells fabricated from a single wafer. 8 refs.

10541 **European progress in photovoltaic development.** Van Overstraeten, R.J. (Leuven Univ., Belgium). pp 1721-1724 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The progress in industrial and in R & D activities in Europe is reviewed. The most important results are emphasized.

10542 **New photovoltaic device research.** Burke, J.R.; Feucht, D.L. (Solar Energy Research Inst., Golden, CO). pp 1771 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

10543 **LPE growth of homojunctions in Ga/sub 1-x/Al/sub x/As for solar cell applications.** Collis, W.J.; Stefanakos, E.K.; Abul-Fadl, A. (North Carolina Agricultural and Tech. State Univ., Greensboro). pp 1772 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

10544 **Fabrication process for Cu_2S-Cds thin film solar cells.** Bloss, W.H.; Arndt, W.; Bilger, G.; Hewig, G.H.; Pfisterer, F.; Schock, H.W. (Stuttgart Univ., Germany). pp 1773-1776 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A fabrication process for Cu_2S-CdS thin film solar cells was developed and is described in detail. The Cu_2S-CdS heterojunction is produced using the Clevite process. Sheet glass is used as substrate and encapsulation. Back contact and n-type CdS-layer are evaporated, whereas the Cu_2S-layers are produced topotaxially in a dipping process. The front contact is produced using silk screening and etching techniques. On a 7 x 7 cm^2 large area substrate glass, encapsulated thin film solar cells with a Cu_2S area of 42 cm^2 are produced, which show conversion efficiencies of 7,3%.

10545 **Advance in the development of low-cost, high performance cadmium-sulfide based thin-film solar cells.** Barnett, A.M.; Meakin, J.D.; Rothwarf, A. (Univ. of Delaware, Newark). pp 1777-1781 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The Institute of Energy Conversion has developed thin-film polycrystalline CdS/Cu_2S solar cells with energy conversion efficiencies in sunlight of up to 9.15%. The improvement from the 7.8% efficiency reported in 1976 is the result of applying a loss minimization methodology to solar cell development. This entails analyzing the losses in energy conversion efficiency for a given cell design and then developing appropriate cell production technology or modified cell designs to reduce or eliminate the primary efficiency reducing mechanisms. The techniques utilized to analyze losses, and the improved designs and production technologies that resulted in systematic increases in energy conversion efficiencies from 7.8 to 8.55 and 9.15% are described. Further design changes and technology development directed by the loss minimization is expected to result in thin film solar cells based on CdS with energy conversion efficiencies of about 14 to 16%. The Institute plans to demonstrate the feasibility of an extremely low-cost manufacturing process with the development of a continuous process pilot plant capable of producing one megawatt annually. Development of this plant, leading to the availability of solar cells at $250/kilowatt will shift the solar electric generation issues from solar cell devices to a strong application orientation.

10546 **MIS solar cells on crystalline, polycrystal, & thin film silicon.** Hyland, S.L. (Rutgers Univ., Piscataway, NJ); Kim, J.K.; Delahoy, A.E.; Anderson, W.A.; Rajkanan, K. pp 1786-1789 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The performance and properties of silicon MIS solar cells were investigated using different types of silicon substrates: single crystal silicon, Silso polycrystalline silicon produced by Wacker Chemitronic, two types of ribbon silicon, and thin silicon films evaporated by electron beam onto titanium substrates. Performance data are presented for each type including efficiency, V/sub oc/, J/sub sc/, and diffusion length. (WHK)

10547 **Performance of silicon solar cells under concentrated sunlight.** Backus, C.E.; Chambers, B.C.; Rule, T.T.; Sanderson, R.W. (Arizona State Univ., Tempe). pp 1798-1802 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Silicon solar cells especially designed for concentration systems are now available with efficiencies of 18 to 19% under illumination levels of 30 to 300 suns at temperatures of 28°C. These efficiencies decrease approximately linearly with temperature. The temperature coefficient decreases slightly at increased concentration levels.

10548 **Reduction of intensity variations on a photovoltaic array with compound parabolic concentrators.** Greenman, P. (Univ. of Chicago, IL); O'Gallagher, J.; Winston, R.; Costogue, E. pp 1808-1812 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

When sunlight is concentrated on an absorbing surface by an ideal concentrator, such as the Compound Parabolic Concentrator (CPC), the instantaneous distribution of intensity across the absorbing surface will not in general be uniform. These non-uniformities may lead to less than optimum power output if the absorber is an array consisting of many interconnected photovoltaic cells. A method for reducing these intensity variations has been found in the context of CPC enhanced photovoltaic arrays in space, namely, the introduction into the reflector surfaces, of small distortions, which may be charactermized by σ, the root mean squared angular deviation of the reflector slope from that of an undistorted CPC. If σ is a non-negligible fraction of the acceptance half-angle θ/sub c/ (e.g., .1θ/sub c/ $\leqq \sigma \leqq$ .9θ/sub c/) the non-uniformities in the intensity distribution are substantially reduced, although some light is lost (i.e., scattered back out the entrance aperture). By controlling σ the tradeoff between uniformity of intensity distribution and loss of concentration can be optimized. Measurements of the intensity distribution performed on a test model with corrugated aluminized mylar reflectors were in good agreement with ray tracing results.

10549 Quasi-static concentrated array with double side illuminated solar cells. Luque, A.; Ruiz, J.M.; Cuevas, A.; Eguren, J.; Sangrador, J.; Sala, G.; Gomez Agost, J.M.; del Alamo, J. (Universidad Politecnica de Madrid, Spain). pp 1813-1817 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Double side illuminated (D.S.I.) cells placed in proper quasi-static concentrators allow for double theoretical gain than that of conventional cells. A concentrator prototype is presented which provides Double side illumination with a practical gain of 8 and an acceptance (half gain) angle of +- 11°. This concentrator also provides cooling for the cells so that they can operate at 10°C over the ambient under an irradiance of 90 mW/cm² and wind velocity of 1 m/sec. Three types of D.S.I. cells are being developed. Practical efficiencies of 15.5% have been practically demonstrated.

10550 Development of 1 pKW photovoltaic module with concentration. Pizzini, S. (Instituto Donegani, Novara, Italy); Giuffrida, M.; Zani, P.; Scarpi, G.; Dionisio, G.; Conti, M.; Modelli, A. pp 1818-1821 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The Italian companies Montedison (Istituto Donegani), Ansaldo, Officine Galileo and SGS/ATES have jointly designed and developed with EEC and CNR financing, a 1 pKW concentration photovoltaic array with silicon cells, afocal lenses and passive cooling. The concentrator consists of a mounting frame, whose tracking mode is alt-azimuthal and ten individual modules. The selected concentration ratio is 50. The afocal lenses provide an optimum flux distribution on the plane of the cell, reduce the incidence of chromatic aberration and tolerate partial shadowing without affecting the illumination profile. The cells, developed by SGS/ATES, have an n/p^+ structure, a Ti-Pd-Ag front metallization pattern, an Al-Cr-Ni-Au back metallization and a silicon nitride AR layer. They display efficiencies in excess of 16%. The tracking system consists of two independent motors for the zenithal and azimuthal movements which are driven by two control units: the azimuthal movement has a constant speed basis plus a superimposed increment derived by the sun sensor. The zenithal movement is completely controlled via a suitable operational amplifier and a comparator, by the sun sensor.

10551 Novel mildly concentrating photovoltaic/thermal total energy system. Strong, S.J. (Solar Design Associates, Canton, MA); Manelas, A.J.; Manasse, F.K. pp 1822-1824 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The design, installation and performance of a mildly concentrating cone collector P.V./Thermal total energy system is described.

10552 Cost effective concentration ratio in high concentration photovoltaic systems. Bendt, P.; Rabl, A. (Solar Energy Research Inst., Golden, CO). pp 1825 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

10553 Effect of different reflector surfaces on photovoltaic concentrator performance. Saylor, W.; Sanchez, J.; Amore, L. (General Electric Co., Valley Forge, PA). pp 1830-1834 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

It is important that reflector materials for photovoltaic concentrators have high reflectance in the region of maximum solar cell response. High average solar hemispherical reflectance alone will not assure high array performance if the reflectance shows a major dip at the wavelengths of the greatest solar cell efficiency. For this reason, it is important to know the full spectral characteristics of a reflector candidate. By convolving this spectrum with both the solar spectrum and solar cell response curves, one obtains a more realistic value for the efficiency expected for a given photovoltaic array. The appropriate functions for determining the contribution of a particular reflector to array performance are presented. The functions are applied to specific reflector materials - silver, aluminum, copper, and gold - to yield an effective reflectane for these, which in general is different from the solar reflectance. Since metals have to be protected by overcoats, a discussion of the effects of protective coatings on reflector candidates is also included.

10554 Design and analysis of a solar cell concentrating system using a flux redistributor. Wennstrom, J.E. (Idaho Power Co., Boise); Warner, R.E. pp 1835-1839 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta GA, USA (28 May 1979).

A concentrating system which focused sunlight on an actively cooled array of silicon solar cells was built and tested. A concentration ratio of 11.7 was provided by a parabolic cylinder with a secondary mirror arrangement near the focal line to redistribute the solar flux. Relationships between optical, electrical, and thermal efficiencies are presented for two mounting positions. Solar cell voltage-current characteristics and the effects of pointing error on cell output power were examined. Test results show the flux redistributor has an equivalent reflectance of .75, but it provides convection suppression, a 1.0 intercept factor, flux uniformity across the cell surface, and insensitivity to tracking or mirror surface errors. The cells produced .05 Wcm^{-2} with a photovoltaic efficiency of 6.5% and a system efficiency of 4.1% for the conversion of direct beam sunlight to electricity at a cell temperature of 64°C.

10555 Effects of encapsulation on the optical and thermal response of solar cells used in concentrated-flux systems. Wood, V.E.; Kenan, R.P.; Gaines, G.B. (Battelle Columbus Labs, OH). pp 1840-1843 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Solar-cell encapsulation for environmental protection affects cells' electrical output and operating temperature. Such effects are particularly significant in concentrator systems requiring high-technology cells and operating above ambient temperature. An initial calculation of effects of encapsulation on optical, thermal, and electrical behavior of low-resistivity solar cells with Fresnel-lens concentrators was performed. The objectives were to determine flux absorbed, power produced, and steady-state temperature distribution; to determine how these quantities changed on encapsulation; to look for beneficial design modifications. Parameters varied included antireflection-coating thickness, ambient temperature, and heat transfer coefficients. Absorbed heat was assumed dissipated by free convection and radiation. Two representative incident solar spectra were considered. Optical, thermal, and electrical analyses were necessarily carried out in an interdependent way. Encapsulation causes unavoidable power reduction which must be balanced against expected service-life improvements. Steady-state cell temperature increases resulting from encapsulation are small.

10556 Connection losses in photovoltaic arrays. Luque, A.; Lorenzo, E.; Ruiz, J.M. (Universidad Politecnica de Madrid, Spain). pp 1851-1855 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The shortcircuit current, opencircuit voltage and connection losses of arrays of solar cells, either for normal or concentrated sunlight are analyzed under either series or parallel connection. The parameters of the individual cells are considered as random variables. The main conclusion reached is that the shortcircuit current of the cells connected in series must be carefully monitored in order to avoid any excessive losses. The losses in parallel arrays are small except in some cases in which the cell parameters suffer from an extreme dispersion.

10557 Potential of crop residues as a fuel for power generation. Bhagat, N.; Davitan, H.; Pouder, R. (Brookhaven National Lab., Upton, NY). pp 2025-2029 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Crop residues, the portions of extractable plant material remaining after crop harvest, could serve as an alternative energy source for electric power generation in agricultural regions of the United States. Current estimates indicate that the US annual production of residues has an energy value of about 5 quads, but, in practice it may be possible to collect only a fraction of this for use as an energy resource. Cost estimates for preparation of residues as fuel indicate they are approximately competitive with conventional fuels with costs ranging from $0.70 to $1.25 per million Btu depending on crop type. Two 3 to 5 kW farm power systems and one 8 MW regional power generator were assessed as to market potential and breakeven capital costs. In some cases, these generators were found to be economically competitive at electricity prices slightly higher than current prices.

10558 Socio-economic aspects of a major US biomass alcohol fuel program. Peters, J.F. (Univ. of Alabama, Huntsville); Ziemke, M.C. pp 2056-2060 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The socio-economic concerns over a national biomass alcohol fuel program are discussed. The hierarchy of goals for such a program is reviewed. The technical considerations that would permit development of a major biomass alcohol fuel program in the United States are illustrated. (MHR)

10559 Energy food interface: an economic analysis of Brazil's alcohol plan. Rask, N. (Ohio State Univ., Columbus); Adams, R.I. pp 2111-2115 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A vertically integrated and regionally competitive linear programming model is used to determine potential adjustments to energy crop production in the agricultural sector. Several agricultural regions are studied. Under present world petroleum prices, alcohol cannot be produced competitively. However, alcohol production is competitive within the energy price policy parameters now existing in Brazil and within present price estimates for other alternatives to petroleum (coal liquefaction, shale oil, etc.). Within the agricultural sector, regional production centers, labor surplus areas and alternative source crops are all competitive with centrally located major sugar production. While increased energy prices reduce agricultural income through increased input costs, energy crop production more than offsets this loss resulting in a net aggregate gain for agricultural income especially in non-mechanized areas. Employment in agriculture also shows net gains with energy crop production.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 10464, 10467, 10468, 10520, 10599, 10600, 11076, 11678, 11679, 11683

10560 (COO—4094-86) Measuring dirt on photovoltaic modules. Part II. Murphy, E.B. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). Nov 1980. Contract AC02-76ET20279. 20p. NTIS, PC A02/MF A01.

The accumulation of surface dirt on photovoltaic (PV) modules installed at MIT Lincoln Laboratory test sites can cause degraded electrical performance until it is removed either by washing or by rain. Modules with only RTV as a solar-cell encapsulant are more prone to dirt retention than modules covered with glass. Two techniques for measuring and quantifying surface dirt and its effects on module output are described. One technique, using a standard portable glossmeter, measures the scattering of specular light by surface-dirt particles. This measured value can then be correlated with the peak power performance before and after cleaning. A second technique is also described which enables an investigator, in the field, to take dirt samples or replicas of the accumulated surface dirt from the PV module. Photomicrographs of urban, suburban, and rural dirt particles are shown. Measurements of module peak power before and after cleaning indicate that dirt particles in urban environments are more degrading to PV performance than dirt particles found in rural areas. The significance of the measurements is not obvious, however, after examination of the photomicrographs of the dirt particles. It was found that the optical transmission of the particles has a greater effect on peak power performance than the quantity of these particles.

10561 (DOE/ET/20279—94) Construction of a photovoltaic power system at Natural Bridges National Monument. Benoit, A.E. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). Dec 1980. Contract AC02-76ET20279. 25p. NTIS, PC A02/MF A01.

In 1979, MIT Lincoln Laboratory, in conjunction with the US Department of Energy and of the Interior, built a 100-kW-peak photovoltaic (PV) power system at Natural Bridges National Monument in Utah. At present, this system is the largest of its kind in the world. The construction phases of the program are described, and a chronological history of the events and problems encountered when such a large and complex task is undertaken in a remote area with very limited fabrication facilities is given. This experiment will demonstrate the application of solar energy to the variety of loads found in a small and remote community. This solar energy system was designed to meet all electrical requirements when there is no utility grid, with only occasional back-up from an existing diesel generator.

10562 (DOE/ET/20279—113) Materials, Processes and Testing Laboratory. Technical progress report, November 1979-February 1980. Forman, S.E.; Themelis, M.P. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 30 Nov 1980. Contract AC02-76ET20279. 41p. NTIS, PC A03/MF A01.

The US Department of Energy has set a 20-year lifetime goal for terrestrial photovoltaic modules. In its capacity as a Photovoltaic Field Test and Application Center, Massachusetts Institute of Technology Lincoln Laboratory has established various experimental test sites, ranging in size from 0.1 to 100 kW of peak power, throughout the United States. These sites contain modules from several manufacturers and serve as test beds for photovoltaic system components. The activities of the Materials, Processes and Testing Laboratory of the Solar Photovoltaic Field Tests and Application Project during the last two months of 1979 and the first two months of 1980 are summarized. Module field inspection, I-V curve plotting, module failure analysis, and module degradation analysis are reported.

10563 (DOE/RA/30351—1) Integration of photovoltaic units into electric utility grids: experiment information requirements and selected issues. (Aerospace Corp., El Segundo, CA (USA)). Sep 1980. Contract AT03-76ET30351. 232p. NTIS, PC A11/MF A01.

A number of investigations, including those conducted by The Aerospace Corporation and other contractors, have led to the recognition of technical, economic, and institutional issues relating to the interface between solar electric technologies and electric utility systems. These issues derive from three attributes of solar electric power concepts, including (1) the variability and unpredictability of the solar resources, (2) the dispersed nature of those resources which suggests the feasible deployment of small dispersed power units, and (3) a high initial capital cost coupled with relatively low operating costs. It is imperative that these integration issues be pursued in parallel with the development of each technology if the nation's electric utility systems are to effectively utilize these technologies in the near to intermediate term. Analyses of three of these issues are presented: utility information requirements, generation mix and production cost impacts, and rate structures in the context of photovoltaic units integrated into the utility system. (WHK)

10564 (PB—80-188212) Mission analysis of photovoltaic solar energy systems. Volume I: summary. Final report. Leonard, S.L. (Aerospace Corp., El Segundo, CA (USA). Energy and Transportation Div.). 1 Dec 1975. 113p. NTIS, PC A06/MF A01.

Results are summarized of a study to develop methods for the technical and economic evaluation of potential applications for photovoltaic solar energy conversion in the southwestern United States in the 1980-2000 period. A secondary objective involves applying the methodology thus developed to evaluate the competitive position of photovoltaic technology in the future energy economy of the Southwest. The conservative approach treats photovoltaic energy conversion as just another competitor in the energy marketplace. A major effort concentrated on two classes of applications: on-site missions and central station power plant applications. The central element of the methodology employed was computer simulation of the performance of photovoltaic systems. Results support the tentative conclusion that with array prices in the $100-100 kWpk range, photovoltic solar energy conversion would be competitive with alternative sources of energy.

10565 (PB—80-188220) Mission analysis of photovoltaic solar energy systems. Volume II: technical report. Final report. Leonard, S.L. (Aerospace Corp., El Segundo, CA (USA). Energy and Transportation Div.). 1 Dec 1975. 231p. NTIS, PC A11/MF A01.

The study focuses on the development and application of procedures for evaluating several classes of applications for photovoltaic solar energy conversion. The three main classes of terrestrial missions for the photovoltaic conversion of solar energy are on-site power generation, central station power generation, and fuel/feedstock production. The procedures developed for evaluating each class include three basic elements: (1) computer simulation, (2) reliability analysis, and (3) economic analysis. Computations using a suitable mathematical model were performed. A major project task applied evaluation methods in preliminary assessments of illustrative examples to each of these mission classes. Results indicate the following: (1) On-site and central station applications appear to be equally attractive as future applications for photovoltaic solar energy conversion; (2) In both of these applications, photovoltaic technology would be competitive with conventional alternatives; and (3) The competitive position of photovoltaic technology in either class of mission would be improved by relaxation of constraints imposed in the illustrative calculations conducted in this study.

10566 (PB—80-188238) Mission analysis of photovoltaic solar energy systems. Volume III: appendices. Final report. Leonard, S.L. (Aerospace Corp., El Segundo, CA (USA). Energy and Transportation Div.). 1 Dec 1975. 105p. NTIS, PC A06/MF A01.

The report comprises six appendices which supplement a study designed to develop methods for the technical and economic evaluation of potential applications for photovoltaic solar energy conversion in the southwestern United States. Appendices A, B, and E contain descriptions of the methodology that was developed in successive Aerospace Corporation Solar Thermal Conversion Mission Analysis studies. These procedures are used in the current photovoltaic study with minor variations. They are entitled 'Demand Forecasting Methodology-I', 'Demand Forecasting Methodology-II', and 'Power Plant Economic Model'. Appendix C describes the system simulation model with respect to subroutine, inputs, and outputs. Appendix F presents projections of unit fuel prices to the year 2000 and includes a detailed analysis of alternative hydrogen production plants.

10567 (SAND—80-7061) Photovoltaic utility/customer interface study. Final report. Eichler, C.H.; Hayes, T.P.; Matthews, M.M.; Wilraker, V.F. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Systems Technology Div.). Dec 1980. Contract AC04-76DP00789. 289p. NTIS, PC A13/MF A01.

The technical, economic, and legal and regulatory issues of interconnecting small, privately-owned, on-site photovoltaic generating systems to an electric utility are addressed. Baseline residential, commercial and industrial class photovoltaic systems were developed. Technical issues of concern affecting this interconnection were identified and included fault protection, undervoltage protection, lamp flicker, revenue metering, loss of synchronism, electrical safety, prevention of backfeeding a de-energized utility feeder, effects of on-site generation on utility relaying schemes, effects of power conditioner harmonic distortion on the electric utility, system isolation, electromagnetic interference and site power factor as seen by the utility. Typical interconnection wiring diagrams were developed for interconnecting each class of baseline photovoltaic generating system. These diagrams incorporated typical protective features currently required by electric utilities. Areas requiring additional technical work are highlighted and include electrical safety, prevention of backfeeding a de-energized feeder, power factor requirements and permissible limits of harmonic injection. An economic evaluation methodology was developed to allow the potential photovoltaic system owner to compare various possible photovoltaic generating system configurations under different utility rate structures and varying economic climates on a consistent basis. The methodology permits calculation of the cost of meeting the customer's energy needs for a specific time period for any given equipment configuration and economic environment.

10568 (SAND—80-7063) 10 kilowatt photovoltaic concentrator system as installed at Sandia Laboratories, 1979. Final technical progress report. Ronney, K. (Spectrolab, Inc., Sylmar, CA (USA)). Dec 1980. Contract AC04-76DP00789. 87p. NTIS, PC A05/MF A01.

The photovoltaic concentrator system designed and installed by Spectrolab, Inc. at Sandia Laboratories, Albuquerque, New Mexico is described. Included are system description, new problems encountered and resolved during fabrication, and system performance analysis.

10569 (SAND—80-7148) Design of a side-by-side photovoltaic thermal system for a Northeast all-electric residence. Mehalick, E.M.; O'Brien, G.; Tully, G.F.; Johnson, J.; Parker, J.; Truncellito, N.; Felice, R. (General Electric Co., Philadelphia, PA (USA). Space Div.). Nov 1980. Contract AC04-76DP00789. 204p. NTIS, PC A10/MF A01.

A side-by-side photovoltaic/thermal system with utility feedback was designed for a two-story all-electric house in the Northeast. The three major system elements are the photovoltaic array, the electric power conversion subsystem, and the thermal subsystem. A key to the sizing of the PV and thermal array is the relative cost of each system. Therefore, the ratio of the costs associated with each system was varied parametrically to define ultimate sizing of the PV and thermal array. In general, the results indicate larger PV array area and minimal thermal array area for the set of cost assumptions described in Appendix E. A thermal system of adequate size, however, was selected to assure sufficient design details for determining system installation costs. The PV system was sized nominally at 6.7 kWp based on roof area limitations. A separate thermal system design was also developed for a side-by-side solar hot water system for comparison. The solar hot water system, since it was less complex and has less components, showed better economic viability than the parallel solar heat pump space heating and hot water system. Both systems will probably be available in the 1986 time frame. The system design and subsystem specifications are presented. (WHK)

10570 (SERI/TR—742-654) Interim performance criteria for photovoltaic energy systems. DeBlasio, R.; Forman, S.; Hogan, S.; Nuss, G.; Post, H.; Ross, R.; Schafft, H. (Solar Energy Research Inst., Golden, CO (USA)). Dec 1980. Contract AC02-77CH00178. 230p. NTIS, PC A11/MF A01.

This document is a response to the Photovoltaic Research, Development, and Demonstration Act of 1978 (P.L. 95-590) which required the generation of performance criteria for photovoltaic energy systems. Since the document is evolutionary and will be updated, the term interim is used. More than 50 experts in the photovoltaic field have contributed in the writing and review of the 179 performance criteria listed in this document. The performance criteria address characteristics of present-day photovoltaic systems that are of interest to manufacturers, government agencies, purchasers, and all others interested in various aspects of photovoltaic system performance and safety. The performance criteria apply to

the system as a whole and to its possible subsystems: array, power conditioning, monitor and control, storage, cabling, and power distribution. They are further categorized according to the following performance attributes: electrical, thermal, mechanical/structural, safety, durability/reliability, installation/operation/maintenance, and building/site. Each criterion contains a statement of expected performance (nonprescriptive), a method of evaluation, and a commentary with further information or justification. Over 50 references for background information are also given. A glossary with definitions relevant to photovoltaic systems and a section on test methods are presented in the appendices. Twenty test methods are included to measure performance characteristics of the subsystem elements. These test methods and other parts of the document will be expanded or revised as future experience and needs dictate.

10571 **Design of a stand-alone 25 kW solar photovoltaic flat panel power supply for an electrodialysis water desalination unit.** Wood, J.R.; Crutcher, J.L. (Mobil Tyco Sol Energy Corp, Waltham, Mass). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference ;* No. 80CH1508-1), 103-108(1980).

A stand-alone power supply consisting of a 25 kW flat panel array employing EFG silicon ribbon solar cells, a 120 kWh deep-discharge lead-acid battery bank, and an electronic control unit, has been designed to provide the complete power requirements of an 8.5 kW electrodialysis water desalination unit. Incorporated are the necessary controls to ensure that the daily and weekly charging cycles for the battery are carried out in the required manner using energy from the array only. The electronic control unit has been assembled and tested with a 1 kW ribbon cell array and a deep-discharge battery bank. 1 ref.

10572 **Design and performance characteristics of a solar photovoltaic power system at the Oklahoma Center for Science and Arts.** Gupta, Y.P. (Sci Appl Inc, McLean, Va). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference ;* No. 80CH1508-1, 109-114(1980). (CONF-800106—).

The design and performance characteristics of a 150 kWp solar PV power system at the Oklahoma Center for Science and Arts are presented. The system utilizes a field of polycrystalline-silicon (poly-si) solar cell modules, rated at 100 kWp and reflector augmentation, 1.35 to 1 peak, to provide 150 kWp. The module-reflector pairs are arranged to maximize output and to meet Center's 1981 winter load requirements. The SOLCEL system simulation program was modified to incorporate the effects of non-uniform illumination, and characteristics of poly-si modules and available power conditioning units. Nearly all of the system output, i.e., about 200 MWh, is utilized on-site. The system is interfaced with the Oklahoma Gas and Electric utility supply to provide back-up power and to accept any excess power generated by the PV system. The system includes appropriate controls, a power monitoring and data acquisition system, and a weather station.

10573 **Commercialization of photovoltaics.** Rappaport, P.; Burke, J.R. (Solar Energy Research Inst., Golden, CO). pp 1725 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

10574 **Mississippi County Community College solar photovoltaic total energy project.** Henry, E.M. (TEAM, Inc., Tucson, AZ); Smith, H.V. pp 1729-1731 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Mississippi County Community College at Blytheville, Arkansas, will derive its electrical and thermal energy from an actively cooled photovoltaic system being developed under the management of TEAM, Inc. This 320 kW concentrator system (DOE standard conditions) will be the world's largest photovoltaic demonstration. The single-axis tracking collectors are 7 foot by 20 foot parabolic troughs with a geometric concentration of 42. The solar cells are single crystal silicon, designed to match the physical and spectral parameters of the collector. The power conditioning system will be utility interactive to provide not only for backup power, but for a power exchange between the solar energy system and the local utility. Process control includes data acquisition on all system components and building demands, as well as required control of all components. Thermal energy from the solar cell coolant will be provided to the college for winter heating and year-round domestic hot water. The energy system is expected to be operational in the winter of 1979, with connection to the college facilities in the summer of 1980.

10575 **Ramon Areces Concentration Photovoltaic Array.** Sala, G.; Araujo, G.L.; Luque, A.; Ruiz, J.M.; Coello, A.; Lorenzo, E.; Chenlo, F.; Sanz, J.; Alonso, A. (Universidad Politencia de Madrid, Spain). pp 1737-1741 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The project of the 1.8 kW Ramon Areces Concentrating Photovoltaic Array is described and the results obtained are presented. The operating characteristics of the array for the year are calculated based on measured parameters of the fabricated cells.

10576 **Solar electric power supply for a VHF radio telephone network in Gabon.** Bielikoff, S.; Boch, J.P. (ELF Aquitaine, Paris, France). pp 1742-1745 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Since 1972 ELF has progressively fitted some of its Gabon offshore production platforms with a telecommunication VHF network powered by photovoltaic generators. About 15 platforms are so equipped with radio-phones over an area of more than 8000 square kilometers and enable the production crews to communicate between themselves, with helicopters and with the shore over distances exceeding 100 km. These equipments operate under very difficult conditions due to heavy marine corrosion combined with an extremely humid equatorial climate prevailing in Gabon. The experience is considered highly satisfactory especially when compared with the former gas turbine and battery system which had a number of problems in the past. Since the installation of these solar panels the network operating costs have dropped to nearly nothing and the reliability has been made nearly 100% as compared to the different other types of power supplies previously employed.

10577 **Autonomous solar-powered beacon for air navigation use.** Lamant, D.; Pero, D. (Instituto Universitario de Tecnologia, Caracas, Venezuela). pp 1746-1748 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The problem of radio aid to air navigation in Venezuela is discussed with regards to the energy supply. The main technical and economical aspects of a solar alternative in relation with the main data of the region are stressed.

10578 **Twenty kW photovoltaic flat panel power system in El Paso, Texas.** Blevins, B. (Solar Energy Inst., Las Cruces, NM); Hsiao, R.; Masud, A.; Zwibel, H.;Brown, J.; Morrison, J.; Golucke, L.; Locke, P. pp 1749-1753 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

This paper reports the design of a 20 kW photovoltaic flat panel power system for an uninterruptible DC power load. Two parallel designs are presented; one with CdS/Cu/sub x/S modules and the other with Si modules. The principal subcomponents and the basic design features are identical for both cases except for the size of the array field. Multiple system design alternatives were generated and judged on the basis of three criteria: system reliability, levelized busbar energy cost, and operational and maintenace

simplicity. The selected system designs were then chosen by making subjective trade-offs between the three criteria.

10579 **Photovoltaic concentrator and flat-panel applications experiments.** Burgess, E.L. (Sandia Labs., Albuquerque, NM). pp 1797 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

10580 **Photovoltaic array reliability project.** Patapoff, N.W. (Southern California Edison, Rosemead). pp 1861-1864 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Southern California Edison, a southwestern electric utility, has installed a 2.2 kW (peak) flat plate photovoltaic array at its General Office in Rosemead, California, a suburb of Los Angeles. The array has given an indication of the reliability and operating characteristics of commercial panels. Results since initial operation in April 1978 have been encouraging. There have been no complete electrical failures, though there has been a significant number of visual degradations. These visual degradations are, for the time being, apparently cosmetic, because no difference was evident between I-V curves taken in June 1978 and April 1979. This project is a first step in the hardware portion of a two-pronged Edison program to examine P/V and its potential to supply energy.

10581 **Solar photovoltaic power for residential use.** Hammond, B. (Motorola Inc., Phoenix, AZ). pp 1875 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

10582 **Dispersed solar electric technologies for the southeast USA: opportunities, applications, and challenges.** Jeter, S.M.; Hill, J.M.; Phan, C.N. (Georgia Inst. of Tech., Atlanta). pp 2010-2013 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The methodology is described and salient results presented for a regional assessment of some aspects of the economic viability and commercialization potential of selected on-site solar electric technologies. Three technological applications were considered as representative of possible on-site solar-electric systems - residential photovoltaic and small wind systems (RPVS and SWECS) and industrial-scale solar total energy systems (STES).

10583 **Comparison of costs for solar derived electrical sources with diesel generators in remote locations.** Manasse, F.K. (Univ. of New Hampshire, Durham); Borofsky, R.L. pp 2102-2106 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Three alternative sources for generating power in remote regions of the world are studied. These include diesel electric, photovoltaic and solar thermal electric devices. Fuel cost, and more specifically, transportation costs of that fuel, dramatically change which device will be most cost effective under specific conditions. In areas where fuel is readily available, diesel appears to be the best alternative financially. Even today, however, solar thermal generators appear to make sense in a number of realistic scenarios, especially those involving LDC's. Photovoltaics do not seem to be competitive at this time, but technical advances may in fact change this in the future. These comparisons are all represented graphically and numerically.

10584 **Interfacing dispersed solar and wind systems with electrical distribution systems.** Ma, F.S.; Chan, M.L.; Curtice, D.H. (Systems Control Inc., Palo Alto, CA). pp 2138-2142 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The results of a research effort to develop a methodology for evaluating the impacts on the planning and operation of the electric distribution systems as a result of increased penetration of dispersed solar and wind (DSW) electric generators are reported. A discussion of the major considerations in the planning and operation of the distribution system when DSW devices are introduced is presented. All of these considerations need to be factored into the cost of service determination for rate designs. Also, the methodology being developed for the analysis is described.

10585 **Viability of solar power satellites as an energy option.** Nansen, R.H. pp Paper 25, 367-381 of Energy: the new rules. Newman, D.T. (ed.). Santa Monica, CA; Management Education Corporation (1979).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

At Boeing, it is believed that an aggressive solar power satellite program could bring the first satellite on line as early as the mid-1990's and that a solar power satellite system could have a substantial impact on the US energy situation by the end of this century. The concept is described and current activity in the US is reviewed. It has been suggested that the system could repay its energy costs within about 3 years. (MCW)

10586 **Design of a photovoltaic solar/electric power plant.** Hochgraef, W.W. pp Paper 40, 30p of Energy: the new rules. Newman, D.T. (ed.). Santa Monica, CA; Management Education Corporation (1979).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

A program to design, construct, and operate a 500 kW concentrator photovoltaic power supply system is briefly described. (WHK)

1407 Solar Thermal Power Systems

10587 (CONF-800334—(Vol.2), pp 449-470) **Preventing eye hazards at the 10 MW solar thermal power plant.** Konopken, S. (Aerospace Corp., El Segundo, CA); Boehmer, C. Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The 10 MW Central Receiver Solar Thermal Power Plant (Pilot Plant) being constructed in the Mojave Desert and some associated human safety concerns are discussed. The magnitude of the safety problems arising from concentrated reflected solar energy is described and solutions for controlling potential hazards are defined. To evaluate the hazard potential, studies were initiated to establish the solar exposure that can injure specific parts of the human body, particularly the retina of the eye. The objective was to specify a maximum permissible exposure (MPE), a level that is safe for human beings. Another series of analyses was to evaluate the evolving heliostat designs to determine the irradiance levels produced in a single heliostat and with multiple heliostat modes. The defining equations are presented in the Appendix along with related subjects. Finally, operational procedures were evolved for each required heliostat movement that will provide levels of safety for personnel and equipment that fall below the specified MPE. Highlights of each of these analytical tasks are presented. (WHK)

10588 (CONF-800334—(Vol.2), pp 490-509) **Environmental concerns for off-normal events with solar thermal power systems.** Perrine, R.L. (Univ. of California, Los Angeles). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

Use of solar energy for electric power generation avoids many risks inherent in more conventional sources. However, as solar technologies are developed, relatively sophisticated design, materials utilization and system operation appear inevitable as means to achieve targets of efficiency, low cost and wide-ranging usage. Unplanned, off-normal events may then become a matter of concern. Environmental risks represent a share of the consequences of off-normal performance. Since the principal exposed population

will be the plant workforce, worker health and safety are the primary environmental concern. Thus management of environmental risk by various means is essential. The study reported has adopted a generic approach to the assessment of environmental concerns for off-normal events. Reference designs and other information have served as a primary basis for undertaking. A balanced effort has considered potential hazards of large system central tower designs such as the 10 MWe Barstow, California, Solar 1 pilot plant, of small system using distributed collectors, and systems such as the Shenandoah, Georgia experimental total energy system. A central task has been to identify the hazards associated with fluids maintained within the STPS plant. In an STPS these differ from usage in conventional (and familiar) fossil-fueled power plant designs. Differences occur in the receiver, electric generation and thermal energy storage subsystems, and also in plant operations and maintenance. Detailed examination of selected off-normal events are studied to illustrate levels of hazard likely to be encountered and possibly useful changes. (WHK)

10589 **(DOE/ET/20314—T1) Conceptual design of advanced central receiver power systems. Phase I.** (Martin Marietta Aerospace Corp., Denver, CO (USA)). 18 May 1978. Contract AC03-77ET20314. 169p. NTIS, PC A08/MF A01.

The status of the program to design a 300 MWe tower focus power plant is reviewed. The plant will utilize a molten salt heat transfer fluid, a water/steam Rankine power cycle, and a sensible heat storage system. System parametric studies, economic analysis, system performance and cost, control subsystem, receiver subsystem, and electric power generation subsystem are described. (WHK)

10590 **(DOE/ET/20550—2(Vol.1)) Line-focus solar central power system, Phase I. Final report, 29 September 1978-30 April 1980. Volume 1. Executive summary.** Slemmons, A.J. (SRI International, Menlo Park, CA (USA)). Apr 1980. Contract AT03-76ET20550. 51p. NTIS, PC A04/MF A01.

The SRI International industrial team completed a subsystem and system parametric analysis, a 100-MW/sub e/ commercial plant conceptual design, a cost and performance analysis, and a commercial assessment. An executive summary is presented in this volume. (WHK)

10591 **(DOE/ET/20550—2(Vol.2)) Line-focus solar central power system, Phase I. Final report, 29 September 1978 to 30 April 1980. Volume II. Text.** Slemmons, A.J. (SRI International, Menlo Park, CA (USA)). Apr 1980. Contract AT03-76ET20550. 414p. NTIS, PC A18/MF A01.

The conceptual design, parametric analysis, cost and performance analysis, and a commercial assessment of a 100-MWe high-temperature line-focus central power system are presented. Parametric analyses and conceptual design of the heliostat subsystem, receiver subsystem, heat transport subsystem, energy storage subsystem, electrical power generating subsystem, and master control subsystem are included. A market analysis and development plan are given. (WHK)

10592 **(DOE/ET/20550—2(Vol.3)) Line-focus solar central power system, Phase I. Final report, 29 September 1978 to 30 April 1980. Volume III. Appendices.** Slemmons, A.J. (SRI International, Menlo Park, CA (USA)). Apr 1980. Contract AT03-76ET20550. 75p. NTIS, PC A04/MF A01.

The conceptual design, parametric analysis, cost and performance analysis, and commercial assessment of a 100-MWe line-focus solar central receiver power plant are reported. This volume contains the appendices: (a) methods of determination of molten salt heat-transfer coefficients and tube-wall temperatures, (b) inputs for STEAEC programs, (c) description of system analysis computer program, (d) receiver analysis program, and (e) heliostat production plan and design methodology. (WHK)

10593 **(PB—80-182819) Design of a cost effective solar powered water pump. Hydrology and hydraulics series report.** Chadwick, D.G. (Utah State Univ., Logan (USA). Utah Water Research Lab.). Apr 1980. 44p. NTIS, PC A03/MF A01.

The design and performance of a vacuum lift, solar powered water pump is discussed. The basic design consists of an expanding gaseous piston confined inside a chamber which is located in series with, and between, an inlet and an outlet check valve. The gas is generated by volatilizing cyclopentane or hexane. Four variations of this basic design concept were built and evaluated. The various features of each are discussed. Considerations in the choice of a cost-effective solar collector are also reviewed. Several of the more promising types of solar collectors were built and evaluated for use on the pump. A 70C heat source temperature is required to operate the pump if cyclopentane is used as the volatile fluid, 90C is required if hexane is used. The volatile fluid is not expended in the pumping process. The pumps constructed on this project have a capacity of approximately 6 liters/minute when pumped to a height of 2 meters. Two square meters of sunshine are sufficient to operate the pump.

10594 **(PNL—3533(Vol.1)) Assessment of generic solar thermal systems for large power applications: analysis of electric power generating costs for systems larger than 10 MWe.** Apley, W.J.; Bird, S.P.; Brown, D.R.; Drost, M.K.; Fort, J.A.; Garrett-Price, B.A.; Patton, W.P.; Williams, T.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1980. Contract AC06-76RL01830. 200p. NTIS, PC A09/MF A01.

Seven generic types of collectors, together with associated subsystems for electric power generation, were considered. The collectors can be classified into three categories: (1) two-axis tracking (with compound-curvature reflecting surfaces); (2) one-axis tracking (with single-curvature reflecting surfaces); and (3) nontracking (with low-concentration reflecting surfaces). All seven collectors were analyzed in conceptual system configurations with Rankine-cycle engines. In addition, two of the collectors were analyzed with Brayton-cycle engines, and one was analyzed with a Stirling-cycle engine. With these engine options, and the consideration of both thermal and electrical storage for the Brayton-cycle central receiver, 11 systems were formulated for analysis. Conceptual designs developed for the 11 systems were based on common assumptions of available technology in the 1990 to 2000 time frame. No attempt was made to perform a detailed optimization of each conceptual design. Rather, designs best suited for a comparative evaluation of the concepts were formulated. Costs were estimated on the basis of identical assumptions, ground rules, methodologies, and unit costs of materials and labor applied uniformly to all of the concepts. The computer code SOLSTEP was used to analyze the thermodynamic performance characteristics and energy costs of the 11 concepts. Year-long simulations were performed using meteorological and insolation data for Barstow, California. Results for each concept include levelized energy costs and capacity factors for various combinations of storage capacity and collector field size.

10595 **Solar and wind energized power generation device.** Adams, J.Y.; Wardman, J.C. US Patent 4,222,241. 16 Sep 1980. Filed date 11 Jan 1979. vp.

An apparatus is described for generating power from the temperature difference between two bodies of fluid, one of which is heated by trapping solar energy in a dome and the other one of which is cooled by wind passing beneath an airfoil. A pair of heat exchange basins are provided into which hot and cold fluid is supplied, with heat exchange coils disposed therein for developing a differential pressure which is transmitted to opposite sides of a piston. The fluid temperature in each heat exchange basin is reversed by gravitational action so that piston motion can be reversed for pumping action.

10596 **Solar heat aperture control apparatus.** Jubb, A. (to Rolls Royce Ltd (United Kingdom)). US Patent 4,222,367. 16 Sep 1980. vp.

A power plant utilizing solar energy as the heat source has a radiant energy heat receiver having a controllable entry aperture for the incoming radiant energy, the aperture being defined by at least three movable shutters, each shutter having a temperature sensing device and operating means which are operable in dependence of the sensed temperature to maintain each shutter in a position corresponding to a predetermined temperature at the entry aperture.

10597 Solar radiant energy heat exchanger. Jubb, A.; Stansbury, E.W. (to Rolls Royce Ltd (United Kingdom)). US Patent 4,222,369. 16 Sep 1980. vp.

A radiant energy heat exchanger for use in a solar energy power plant comprises one or more banks of heat exchange ducts, each bank of ducts having an inlet and an outlet manifold to receive and discharge the medium to be heated. The ducts are curved along their length between the inlet and outlet manifolds so that the amount of radiant energy falling on the ducts per unit area of duct decreases between the inlet and outlet manifolds at such a rate that the duct temperature is substantially constant between the manifolds while the temperature of the medium being heated increases, the radiant energy falling on the ducts being substantially unidirectional.

10598 Development and validation of a market penetration model for Solar Total Energy Systems. Bush, L.R.; Munjal, P.K. (Aerospace Corp., El Segundo, CA). pp 2015-2019 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Mission analysis of Solar Total Energy Systems (STES) has led to the development of a unique computer code for predicting market penetration. Instead of assuming an S-shaped penetration curve and estimating the constants, the model looks at the economics of STES as a function of industry characteristics, location and time, and aggregates the results to obtain STES penetration by region and fuel type. A limited survey of the more promising STES candidates was also made to validate some of the assumptions and relationships used in the Market Penetration Model.

10599 Survivability of alternate energy systems. Tolbert, W.A. (Air Force Engineering and Services Center, Tyndall AFB, FL); Mantz, M.R.; Scheuch, K.E.; Baird, G.T. pp 2061-2065 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The findings of an Air Force study of the survivability, reliability and maintainability of typical alternate energy systems being considered by the Air Force for remote site applications are reported. Primary emphasis of the study involves survivability of alternate energy systems in a variety of attack scenarios, civil disturbances, and natural disasters. Only those threats which are of prime interest to the civilian community are addressed.

10600 Benefit-cost analysis of the impact upon an existing utility of a solar electric experimental facility. Murry, D.A. (Stone and Webster Management Consultants Inc., Washington, DC); Zumwalt, R. pp 2148-2151 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The New Mexico Electric Service Company is used as a test case to assess the potential benefits and costs of interconnecting the system with a solar electric experimental facility. Eight solar electric configurations, each with and without storage, are considered at two separate sites. The potential benefits-costs vary considerably depending upon the scenario chosen.

10601 Prediction of global solar electricity market, in connection with geographical distribution of decentralized and centralized electrical demand up to year 2025. Claverie, M.J.; Dupas, A.P. (Centre National de la Recherche Scientifique, Paris, France). pp 2152-2156 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Starting from hypothesis of moderate growth for energy demand through 2000 to 2025, we have computed the potential production of Solar Power Plants. For this purpose, we have developed a numerical model predicting the future demands for centralized and decentralized electrical energy according to geographical position. The inputs of this model are: the geographical distribution of population at the present time, the energy demand growth in the different world regions, the part of energy consumption used for electricity generation in each world region. The partition of electrical demand between centralized and decentralized needs is made according to the density of electrical consumption. We have used, as energy demand growth hypothesis, results from the reports of the Conservation Commission of the World Energy Conference (1977) and the work of the Case Western Reserve University. Our model leads to a market of 1000 GW of Solar Power Plants in 2025, producing 2500 Twh/year, i.e. 5% of global electricity demand. But these power plants would supply electricity to 17 to 28% of mankind.

1408 Ocean Thermal Gradient And Salinity Gradient Power Systems

10602 (ANL/OTEC-BCM—015) Effect of seawater environmental exposure on fatigue properties of polyethylene pipe. Tipton, D.G. (LaQue Center for Corrosion Technology, Inc., Wrightsville Beach, NC (USA)). Oct 1980. Contract W-31-109-ENG-38. 30p. NTIS, PC A03/MF A01.

One laboratory study at NIT was reported to show an unexpected decrease in crystallinity for a polyethylene material exposed to fatigue loading in a synthetic seawater solution. High density polyethylene Sclairpipe, from the OTEC-1 cold water pipe, was evaluated for resistance to corrosion fatigue in natural seawater. Intermediate crystallinity measurements (via bulk density) showed no effect of corrosion fatigue exposure. Heat of fusion (a relative indicator of crystallinity) also showed no effect of the exposure. Seawater exposure produced no significant change in tensile strength. One failure was observed during the corrosion fatigue tests and was attributed to porosity observed by fractography. These data suggest that high density polyethylene is not significantly sensitive to degradation of fatigue strength in natural seawater.

10603 (CONF-800334—(Vol.2), pp 417-435) Environmental assessment and monitoring program for Ocean Thermal Energy Conversion (OTEC). Wilde, P. (Lawrence Berkeley Lab., CA). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

Ecologically sound operations of projected Ocean Thermal Energy Conversion (OTEC) plants can be insured by careful attention to the marine environment during the design phase. This requires quality information from regions of potential OTEC interest. Currently, preliminary or actual surveys and laboratory studies are being conducted in the waters of Puerto Rico, the Gulf of Mexico, Hawaii, and Guam for potential moored OTEC plants and in the equatorial south Atlantic for proposed plant-ship operations to provide such benchmark and baseline data. These data plus existing archival information can be used to model effects of OTEC operations based on projected design schemes. Four major areas of concerns (1) redistribution of oceanic properties, (2) chemical pollution, (3) structural effects, and (4) socio- legal-economic, and 11 key issues associated with OTEC deployment and operation have been identified. In general, mitigating strategies can be used to alleviate many deleterious environmental effects of operational problems as biostimulation, outgassing, etc. Various research studies on toxicity, biocide releases, etc., are under way or are planned to investigate areas where no clear mitigating strategy is available. A Master Plan listing procedures to be followed to identify and evaluate potential concerns at any OTEC proposed site is proposed for discussion and refinement in advance of any real OTEC test operations.One year's monitoring at benchmark sites in the Gulf of Mexico (Tampa and Mobile); Puerto Rico (Punta Tuna); Hawaii (Kona Coast/OTEC-1); and at the grazing ship site (Equatorial South Atlantic) have been completed. Archival studies have begun for Guam and a new benchmark site (southwest Oahu) will be occupied in early 1980. Data from these sites will be analyzed to be available to aid in site selection for future test deployments.

10604 **(DOE/ER/10596—1) Conditions for dropwise condensation on electroplated gold. Progress report, February 15, 1980 to February 14, 1981.** Westwater, J.W. (Illinois Univ., Urbana (USA). Dept. of Chemical Engineering). Dec 1980. Contract AC02-80ER10596. 5p. NTIS, PC A02/MF A01.

This research is concerned with the use of thin coatings of gold on metal to produce dropwise condensation of steam. Dropwise condensation is preferred to filmwise condensation, because it has much larger heat transfer coefficients. The use of dropwise condensation in ocean thermal energy conversion could result in dramatic reductions in the size of heat exchangers. Progress during the year consisted of numerous tests on a variety of electroplated gold surfaces, with and without brighteners, deposited from sulfite and from cyanide solutions. Tests also were made with gold deposited from solution by non-electrolytic means and with gold deposited from vapor. Additional tests were made with a solid, pure gold test piece subjected to mechanical, chemical, and ion-bombardment cleaning procedures. The test surfaces were analyzed chemically by auger spectroscopy and optically by electron microscopy. To date, the tests support a hypothesis that the role of gold is to provide an oxide-free surface for tenacious organic adsorption. The work will continue and is being expanded to include silver coatings.

10605 **(DOE/ET/20483—7) Theoretical and experimental study of the intermediate field dynamics of ocean thermal energy conversion plants. Progress report 1978-1979.** Jirka, G.H.; Jones, J.M.; Sargent, F.E. (Cornell Univ., Ithaca, NY (USA). School of Civil and Environmental Engineering). Mar 1980. Contract AS02-78ET20483. 152p. NTIS, PC A12/MF A01.

Results are described of a two-year research effort which has been conducted with the following objectives: (1) investigate analytically and experimentally the intermediate field spreading in a steady ocean current; (2) investigate analytically and experimentally the transient intermediate field spreading in a stagnant ocean; (3) compare the results with other available data on buoyancy driven currents in stratified surroundings, including the concurrent experimental program at MIT Parsons Laboratory; and (4) use the results in the formulation of preliminary siting guidelines for multiple OTEC plant interactions. The theoretical background for the intermediate field spreading is given including both steady-state and transient results. The experiments performed in the Stratified Flow Modeling Basin at Cornell University are described, and the data are compared to the theoretical results and to available experimental data from other sources. The application of the intermediate field results to the OTEC design problem is discussed. Typical intermediate field behavior is predicted for different plant sizes (100 MW/sub e/ and 1 MW/sub e/), designs and ambient ocean conditions. (WHK)

10606 **(DOE/ET/21002—T10) OTEC support services. Quarterly technical progress report No. 10, 15 August 1980-14 November 1980.** (VSE Corp., Alexandria, VA (USA)). Nov 1980. Contract AC02-78ET21002. 26p. NTIS, PC A03/MF A01.

OTEC system integration, engineering, and management services provided by the VSE Corporation for the DOE Division of Ocean Energy Systems from August 15 through November 14, 1980 are reported. (WHK)

10607 **(DOE/NOAA/OTEC—14(App.)) Ocean thermal energy conversion cold water pipe preliminary design project. Appendices to final report.** (TRW, Inc., McLean, VA (USA). Energy Systems Group). 20 Nov 1979. Contract AI01-77ET20396. 349p. NTIS, PC A15/MF A01.

Portions of document are illegible.

NOAA/DOE has selected three concepts for a baseline design of the cold water pipe (CWP) for OTEC plants: (1) a FRP CWP of sandwich wall construction suspended from the Applied Physical Laboratory/John Hopkins University (APL/JHU) barge at a site 200 miles east of the coast of Brazil using a horizontal deployment scheme; (2) an elastomer CWP suspended from the APL/JHU barge off the southeast coast of Puerto Rico using either a horizontal or vertical deployment scheme; and (3) a polyethylene CWP (single or multiple pipe) suspended from the Gibbs and Cox spar at the Puerto Rico site using a horizontal deployment scheme. TRW has developed a baseline design for each of these configurations. This volume of the report includes the following appendices: (A) fiberglass reinforced plastic cold water pipe (specification and drawingss); (B) specification for polyethylene CWP; (C) elastomer pipe drawings; (D) drawings for OTEC 10/40 hull/CWP transitions; (E) structural design of OTEC 10/40 CWP support and CWP transitions; (F) universal transition joint for CWP; (G) dynamic spherical seal of CWP; (H) at-sea deployment loads - surface towing loads; (I) OTEC 10/40 CWP deployment up-ending loads; (J) cost estimates for OTEC 10/40 hull/CWP transitions; and (K) OTEC 10/40 CWP deployment scenario and cost estimate. (WHK)

10608 **(DOE/NOAA/OTEC—15(Summ.)) OTEC modular experiment plant cold water pipe system design study. Executive Summary.** (Science Applications, Inc., El Segundo, CA (USA)). Dec 1979. Contract AI01-77ET20396. 72p. NTIS, PC A04/MF A01.

Portions of document are illegible.

The OTEC Cold Water Pipe System Study was undertaken to evaluate the diverse CWP concepts, recommend the most viable alteratives for a 1984 deployment of the 10/40 MWe MEP, and develop selected designs. Specific objectives of the study were to prepare candidate CWP concepts for stationary and grazing mode OTEC plants along with fabrication/construction/installation plans and cost estimates. CWP designs were to be integrated with the relevant subsystems, have a thirty year design life, meet the imposed performance criteria and be cost effective. Three concepts selected by the government were then to be developed through baseline design. In the first phase of the study a system analysis was performed to evaluate alternative concepts. Baseline configurations were proposed, and significant engineering development was expended to bring the concepts to a sufficient design state such that technical feasibility, schedule, and cost judgments could be made rationally. Fabrication, construction, and installation plans were developed for successful concepts, and costs were determined in a WBS format. Evaluations were performed on the basis of technical and cost risk. (WHK)

10609 **(DOE/NOAA/OTEC—27) OTEC elastomer cold water pipe preliminary design study. Final report, August-November 1979.** Mehring, R.D. (Goodyear Aerospace Corp., Akron, OH (USA)). 13 Nov 1979. Contract AI01-77ET20396. 77p. NTIS, PC A05/MF A01.

Goodyear Aerospace Corporation has analyzed the requirements for a 30 ft dia 3280 ft long Cold Water Pipe for an Ocean Thermal Energy Conversion (OTEC) 10/40 MW Pilot Plant. A preliminary design using elastomer covered, flexible steel cable, conveyor belt material is presented. The design concept was predicated on employing state-of-the-art production techniques and having the capability for expansion to a commercial power plant size without further development. A data base for a compliant elastomer pipe is provided including material properties, design details, cost, fabrication and schedule information. Both cable and fabric reinforced constructions are addressed and a comparison of various concepts for assembly of the pipe sections is made.

10610 **(DOE/NOAA/OTEC—30(Vol.3)) Preliminary designs for modular OTEC platforms' station-keeping subsystems. Final report.** (Rosenblatt (M.) and Son, Inc., New York (USA)). 29 Feb 1980. Contract AI01-77ET20396. 176p. NTIS, PC A09/MF A01.

Portions of document are illegible.

This volume of the report presents the results of the third through the sixth tasks of the Station Keeping Subsystem (SKSS) design studies for 10/40 MW/sub e/ capacity OTEC Modular Experiment platforms (MEP). The tasks are (3) complete preliminary designs for one SKSS for each of the two platforms (SPAR and BARGE); (4) development and testing recommendations for the MEP SKSS; (5) cost - time analysis; and (6) commercial plant recommendations. The government, with the objective of developing state-of-the-art mooring systems for both platforms, assigned MR and S multi-point spread catenary mooring concepts for the preliminary design work. The analytical work performed in connection with this design is described in detail. The overall conclusions and recommendations for the modular, as well as the commercial, OTEC platform station keeping subsystems are delineated. The basic design assumptions made during the process, the technical ap-

proach followed, and the results of design iterations, reliability and performance analyses are given. The summary cost estimates for each of the alternative SKSS concepts considered are given, and a time schedule for the recommended concept is provided. The effects of varying some of the important parameters used in SKSS design on the performance and cost of the mooring system are investigated and results presented. The tests required and other developmental recommendations in order to verify and confirm the basic design assumptions are discussed. (WHK)

10611 **(DOE/NOAA/OTEC—30(Vol.4)) OTEC SKSS preliminary designs. Volume 4. Appendixes. Final report.** (Rosenblatt (M.) and Son, Inc., New York (USA)). 29 Feb 1980. Contract AI01-77ET20396. 351p. NTIS, PC A16/MF A01.

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The Station Keeping Subsystem (SKSS) design studies for 10/40 MWe capacity OTEC modular experiment platforms are presented. This volume of the report includes the following appendices: (A) detailed drag calculations; (B) sample CALMS computer printouts for SPAR and BARGE static analyses; (C) sample time domain computer printouts (Hydromechanics, Inc.) program; (D) extreme value and fatigue load calculations; (E) anchor design calculations; (F) deployment calculations; (G) bottom slope plots; (H) Time Domain Analysis report by Hydromechanics Inc.; (I) detailed cost analysis; (J) control systems study report by Sperry Systems Management; (K) cost estimates for Model Basin Tests; and (L) hydrodynamic loading on the mooring tables. (WHK)

10612 **(DOE/NOAA/OTEC—32(Vol.3)(App.)) OTEC modular experiment cold water pipe concept evaluation. Volume III. Appendices.** (Science Applications, Inc., El Segundo, CA (USA)). Apr 1979. Contract AI01-77ET20396. 268p. (SAI—063-80R-008-LA(Vol.3)(App.)). NTIS, PC A12/MF A01.

Portions of document are illegible.

The Cold Water Pipe System Design Study was undertaken to evaluate the diverse CWP concepts, recommend the most viable alternatives for a 1984 deployment of the 10 to 40 MWe MEP, and carry out preliminary designs of three concepts. The concept evaluation phase reported involved a systems analysis of design alternatives in the broad categories of rigid walled (with hinges), compliant walled, stockade and bottom mounted buoyant. Quantitative evaluations were made of concept performance, availability, deployment schedule, technical feasibility and cost. CWP concepts were analyzed to determine if they met or could be made to meet established system requirements and could be deployed by 1984. Fabrication, construction and installation plans were developed for successful concepts, and costs were determined in a WBS format. Evaluations were performed on the basis of technical and cost risk. This volume includes the following appendices: (A) materials and associated design criteria; (B) summary of results of dynamic flow and transportation analysis; (C) CWP sizing analysis; (D) CWP thermal performance; and (E) investigation of the APL/ABAM CWP design. (WHK)

10613 **(PB—80-182074) Design and analysis of OTEC's cold water pipe.** Scotti, R.; McGuinness, T. (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Office of Ocean Engineering). Feb 1980. 21p. NTIS, PC A02/MF A01.

The Ocean Thermal Energy Conversion (OTEC) Program of the Department of Energy (DOE) is developing an engineering design manual for the OTEC Cold Water Pipe (CWP). Nominal dimensions of the pipes now under study have lengths to 1,000 meters, diameters of 9 meters and thicknesses ranging from 0.07 to 0.6 meters, depending on materials. Under the action of unsteady, three-dimensional hydrodynamic loads, as well as loads due to coupled surface platform motions, the CWP is subject to a combination of bending, torsional, and ovaling modes of oscillation. The CWP Engineering Design Manual will contain essential information and analytical models for CWP design and design assessment. This paper focuses on the problem of CWP structural analysis and describes CWP hydrodynamic loading forces and existing linear elastic beam CWP structural models. Sample calculations are presented which illustrate structural response predictions for the CWP in typical seas and demonstrate tentative agreement for a limited range of parameters between the three most widely used CWP structural models and the scant existing experimental data.

10614 **(SAN—1568-78/1) Ocean thermal energy conversion (OTEC) power system development. Conceptual design.** (Lockheed Missiles and Space Co., Sunnyvale, CA (USA). Ocean Systems Div.). 30 Jan 1978. Contract AC03-77ET20299. 438p. (LMSC-D—566744). NTIS, PC A19/MF A01.

The conceptual design of a power system for application to the OTEC 100-MWe Demonstration Plant is presented. System modeling, design, and performance are described in detail. Materials considerations, module assembly, and cost considerations are discussed. Appendices include: A) systems analysis, B) general arrangements, C) system equipment, D) ammonia system material considerations; E) ammonia cycle, F) auxiliary subsystems, G) DACS availability analysis, H) heat exchanger supporting data, I) rotating machinery, and J) platform influences. (WHK)

10615 **(SAN—1568-78/4) Ocean thermal energy conversion power system development-I. Phase I. Final report.** (Lockheed Missiles and Space Co., Sunnyvale, CA (USA). Ocean Systems Div.). 18 Dec 1978. Contract AC03-77ET20299. 38p. (LMSC-D—630737). NTIS, PC A03/MF A01.

The objective of the Ocean Thermal Energy Conversion (OTEC) Power System Development-I (PSD-I), Phase I, study was to develop conceptual and preliminary designs of closed-cycle ammonia power system modules for the 100-MW(e) OTEC Demonstration Plant, the 400-MW(e) Commercial Size Plant, and Heat Exchanger Test Articles representative of the full-size power system module design. Results are presented.

10616 **(SAN—1568-78/4(Vol.1)) Ocean thermal energy conversion power system development-I. Phase I. Preliminary design report. Volume 1. Final report.** (Lockheed Missiles and Space Co., Sunnyvale, CA (USA). Ocean Systems Div.). 18 Dec 1978. Contract AC03-77ET20299. 377p. (LMSC-D—630737(Vol.1)). NTIS, PC A17/MF A01.

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The results of a conceptual and preliminary design study of Ocean Thermal Energy Conversion (OTEC) closed loop ammonia power system modules performed by Lockheed Missiles & Space Company, Inc. (LMSC) are presented. This design study is the second of 3 tasks in Phase I of the Power System Development-I Project. The Task 2 objectives were to develop: 1) conceptual designs for a 40 to 50-MW(e) closed cycle ammonia commercial plant size power module whose heat exchangers are immersed in seawater and whose ancillary equipments are in a shirt sleeve environment; preliminary designs for a modular application power system sized at 10-MW(e) whose design, construction and material selection is analogous to the 50 MW(e) module, except that titanium tubes are to be used in the heat exchangers; and 3) preliminary designs for heat exchanger test articles (evaporator and condenser) representative of the 50-MW(e) heat exchangers using aluminum alloy, suitable for seawater service, for testing on OTEC-1. The reference ocean platform was specified by DOE as a surface vessel with the heat exchanger immersed in seawater to a design depth of 0 to 20 ft measured from the top of the heat exchanger. For the 50-MW(e) module, the OTEC 400-MW(e) Plant Ship, defined in the Platform Configuration and Integration study, was used as the reference platform. System design, performance, and cost are presented. (WHK)

10617 **(SAN—1568-78/4(Vol.3)) Ocean thermal energy conversion power system development-I. Preliminary design report. Volume 3. Appendixes D, E, and F. Phase I. Final report.** (Lockheed Missiles and Space Co., Sunnyvale, CA (USA). Ocean Systems Div.). 18 Dec 1978. Contract AC03-77ET20299. 642p. NTIS, PC A99/MF A01.

The conceptual design of a 40 to 50 MW closed cycle ammonia OTEC commercial plant, the preliminary design of a 10 MW OTEC module analogous to the 50 MW module, and the preliminary design of heat exchanger test articles (evaporator and condenser) representative of the 50 MW heat exchangers for testing in OTEC-1 are presented. This volume includes the appendices: D)

system equipment (hardware breakdown structure; 10-MW hardware listing; list of support and maintenance equipment, tools and spare parts; sacrificial anodes; M.A.N. brush; and Alclad 3004 data); E) heat exchanger supporting data (analyses/configuration, contract tooling, manufacturing plan, specification, and evaporator ammonia liquid distribution system); and F) rotating machinery (performance characteristics, radial inflow turbine; item descriptions; weight calculation-rotor; producibility analysis; long lead-time items; spares; support equipment; non recurring costs; performance characteristics-axial flow turbine; Worthington pump data; and American M.A.N. Corporation data). Also included is attachment 1 to the phase I final report which presents details of the system modeling; design, materials considerations, and systems analysis of the baseline module; system cost analysis; and supporting data. (WHK)

10618 **(SAN—1568-78/4(Vol.4)) Ocean thermal energy conversion power system development-I. Volume 4. Appendix G. Preliminary design report.** (Lockheed Missiles and Space Co., Sunnyvale, CA (USA). Ocean Systems Div.). 18 Dec 1978. Contract AC03-77ET20299. 378p. (LMSC-D—630737(Vol.4)). NTIS, PC A17/MF A01.

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The conceptual design of a 40 to 50 MW closed cycle ammonia OTEC commercial plant, the preliminary design of a 10 MW OTEC module analogous to the 50 MW module, and the preliminary design of heat exchanger test articles (evaporator and condenser) representative of the 50 MW heat exchangers for testing in OTEC-1 are presented. This volume of the report presents Appendix G: ammonia cycle, auxiliaries and ancillaries. Design descriptions are given (for the 50 MW commercial plant and the 10 MW module) for the ammonia vapor and condensate systems, ammonia storage and fill systems, noncondensible gas removal systems, ammonia cleanup systems, ammonia unloading systems, leak detection systems, and fluid sampling systems. (WHK)

10619 **(SAN—1568-78/4(Vol.5)) Ocean thermal energy conversion power system development: I. Preliminary design report. Phase I. Volume 5. Appendixes H, I, J, and K. Final report.** (Lockheed Missiles and Space Co., Sunnyvale, CA (USA). Ocean Systems Div.). 18 Dec 1978. Contract AC03-77ET20299. 226p. (LMSC-D—630737(Vol.5)). NTIS, PC A11/MF A01.

Portions of document are illegible.

The conceptual design of a 40 to 50 MW closed cycle ammonia OTEC commercial plant, the preliminary design of a 10 MW OTEC module analogous to the 50 MW module, and the preliminary design of heat exchanger test articles (evaporator and condenser) representative of the 50 MW heat exchangers for testing in OTEC-1 are presented. This volume of the report includes the following appendices: H) conceptual design description of the electrical systems; I) control and instrumentation; J) OTEC power module assembly; and K) cost estimates for each of the cost components. (WHK)

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 10462, 10463, 10469, 10471, 10475, 10569, 10661, 10677, 10677, 10701, 11146, 11152, 11153, 11167

10620 **Development of retrofit solar heating systems.** Edgel, W.R. (Univ of NM, Albuquerque). pp 269-284 of Technology energy conservation. Silver Spring, MD; Information Transfer Inc. (1979).

From 3. national conference and exhibition on technology for energy conservation; Tucson, AZ, USA (22 Jan 1979).

Four specific objectives of this program are: (1) determine the nature and distribution of types of existing buildings in New Mexico; (2) identify several opportune situations for retrofit solar heating systems, which have wide applicability to existing buildings in the state; (3) design retrofit solar heating systems which capitalize on the identified situations; and (4) assess the technical and economic feasibility of the designs developed by the use of simplified calculational models. 3 refs.

10621 **(AD-A—085815) Solar heating of buildings and domestic hot water. revision. Final report Oct 78-Apr 80.** Durlak, E.R. (Civil Engineering Lab. (Navy), Port Hueneme, CA (USA)). May 1980. 182p. NTIS, PC A09/MF A01.

This report presents design criteria and cost analysis for methods for the sizing and justification of solar heat collectors for potable water heaters and space heaters. Sufficient information is presented to enable engineers to design solar space and water heating systems or conduct basic feasibility studies preparatory to design of large installations. Both retrofit and new installations are considered. This report has been substantially revised from the previous edition (Beck and Field, 1977). However, most of the revision is in Section 2.0, where more material of an exploratory nature has been added. Section 3.0, which contains the calculation method and worksheets, is largely the same, except that the economic analysis has been revised and new tables have been added to provide a self-contained source of meteorological data and collector test data.

10622 **(AD-A—086757) Analysis of a residential heating system utilizing a solar assisted water-to-air heat pump. Master's thesis.** Dunbar, J.R. (Naval Postgraduate School, Monterey, CA (USA)). Jul 1979. 73p. NTIS, MF A01.

The performance characteristics of a residential solar assisted water-to-air heat pump heating system were analyzed. A realistic residence and solar assisted water-to-air heat pump system were modeled for this northern climate using the transient simulation computer code TRNSYS developed by the University of Wisconsin. The system was studied over a one month winter period, December, using actual hourly weather data. The system was analyzed for both the cloudiest and clearest December weather recorded in the last 30 years. The collector area and storage tank capacity were varied and the effects on system performance were studied. Other parameters varied and studied are the collector/storage tank heat exchanger effectiveness and the room temperature.

10623 **(ANL/EES-TM—115(Vol.2)) Solar reliability and materials library. Volume 2. User's manual.** Singh, H.; Wolosewicz, R.M.; Singh, I. (Argonne National Lab., IL (USA)). Sep 1980. Contract W-31-109-ENG-38. 131p. NTIS, PC A07/MF A01.

This user's manual is the second of two volumes documenting the solar reliability and materials program (SRMP) library at Argonne National Laboratory (ANL). The first volume presents an overview of the solar reliability and materials library. This volume describes the data card formats, identification codes, and dictionaries used in recording data and compiling reliability statistics on solar energy systems. The library is structured around the solar heating and cooling system demonstration sites sponsored by the Department of Energy (DOE). Sufficient flexibility has been built into the coding plan to expand the library to include other solar energy systems. As with any reliability library, the structure will change with time and the needs of the solar energy community. As changes in structure occur, updated editions of the user's manual will be issued to incorporate them. Some of the programs that have been developed using the Statistical Analysis System (SAS) processor are presented to indicate the steps to be followed in linking the various SAS procedures into a production algorithm. Because SAS is a versatile system, other programs and outputs can be generated.

10624 **(CONF-8009127—1) Building sector: state of the market and two models on how to reach it.** Holtz, M.J. (Solar Energy Research Inst., Golden, CO (USA)). 30 Aug 1980. Contract AC02-77CH00178. 12p. NTIS, PC A02/MF A01.

From Mid-America solar update conference; Saint Paul, MN, USA (9 Sep 1980).

Two subjects related to marketing solar energy in the buildings sector are discussed: first, the market size defined in terms of number of housing units and square feet of commercial floor space and their energy use characteristics and, second, several models SERI has developed and is using to move solar energy/energy efficiency into the mainstream of residential and commercial building construction. (MHR)

10625 (COO—2859-25) Engineering design construction and testing of a salt-water absorption unit optimized for use with a solar collector heat source. Ferguson, T.; Merrick, R.H. (Arkla Industries, Inc., Evansville, IN (USA)). Mar 1979. Contract AC03-76SF10507. 45p. NTIS, PC A03/MF A01.

The development of a 3 ton direct evaporatively cooled LiBr chiller and the construction of three operable field test units suitable for use with flat plate collectors is reported. Compared to conventional LiBr chillers using shell and tube heat exchangers and a separate cooling tower this approach aims to reduce first cost, installation cost and parasitic power. The unit is packaged into a size approximately 94 cm square and 2 meters tall. It produces 7.2°C (45F) chilled water with a .72 COP when fired with 89.4°C (193F) hot water while rejecting heat to 25.6°C (78F) wb ambient air. Power to operate the condenser fan, solution pump and surface wetting pump is 450 watts. This unit deals with water freezing by making the sump and wetting pump freeze resistant so that seasonal draining is not required. Low heat flux through the wetted surfaces yields performance insensitivity to the accumulation of scale.

10626 (DOE/CS—4970-1) Passive and Hybrid Solar Energy Program. (Decision Planning Corp., Costa Mesa, CA (USA)). Nov 1980. Contract AT02-77CH99002. 310p. NTIS, PC A14/MF A01.

The background and scope of the program is presented in general terms. The Program Plan is summarized describing how individual projects are categorized into mission-oriented tasks according to market sector categories. The individual projects funded by DOE are presented as follows: residential buildings, commercial buildings, solar products, solar cities and towns, and agricultural buildings. A summary list of projects by institution (contractors) and indexed by market application area is included. (MHR)

10627 (DOE/CS/31522—T1) Solar space and water heating system at Stanford University Central Food Services Building. Final report. (Stanford Univ., CA (USA)). May 1980. Contract AB03-77CS31522. 143p. NTIS, PC A11/MF A01.

This active hydronic domestic hot water and space heating system was 840 ft² of single-glazed, liquid, flat plate collectors and 1550 gal heat storage tanks. The following are discussed: energy conservation, design philosophy, operation, acceptance testing, performance data, collector selection, bidding, costs, economics, problems, and recommendations. An operation and maintenance manual and as-built drawings are included in appendices. (MHR)

10628 (DOE/CS/32224—T1) Handbook of experiences in the design and installation of solar heating and cooling systems. Ward, D.S.; Oberoi, H.S. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Jul 1980. Contract AC01-76CS32224. 231p. NTIS, PC A11/MF A01.

A large array of problems encountered are detailed, including design errors, installation mistakes, cases of inadequate durability of materials and unacceptable reliability of components, and wide variations in the performance and operation of different solar systems. Durability, reliability, and design problems are reviewed for solar collector subsystems, heat transfer fluids, thermal storage, passive solar components, piping/ducting, and reliability/operational problems. The following performance topics are covered: criteria for design and performance analysis, domestic hot water systems, passive space heating systems, active space heating systems, space cooling systems, analysis of systems performance, and performance evaluations. (MHR)

10629 (DOE/ET/20108—T2) SOLCOST - Version 3.0. Solar energy design program for non-thermal specialists. (Martin Marietta Aerospace, Denver, CO (USA)). May 1980. Contract AC02-76ET20108. 281p. NTIS, PC A13/MF A01.

The SOLCOST solar energy design program is a public domain computerized design tool intended for use by non-thermal specialists to size solar systems with a methodology based on life cycle cost. An overview of SOLCOST capabilities and options is presented. A detailed guide to the SOLCOST input parameters is included. Sample problems showing typical imput decks and resulting SOLCOST output sheets are given. Details of different parts of the analysis are appended. (MHR)

10630 (DOE/R5/10164—2) Solar heating demonstration. Final report. Bonicatto, L.; Kozak, C. (Hayward Community Schools, WI (USA)). 1980. Contract FG02-79R510164. 5p. NTIS, PC A02/MF A01.

The demonstration involved a 4-panel solar collector mounted on the industrial arts building. A 120 gallon storage tank supplements a 66 gallon electric hot water heater which supplies hot water for 5 shop wash basins, girl's and boy's lavatories, and a pressure washer in the auto shop. The installation and educational uses of the system are described. (MHR)

10631 (EUR—6645) Development of practical aids for the optimization of solar techniques. Final report. Denton, R.; Holzer, G.; Hudetz, W.; Mentzel, T.; Reichert, J. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Karlsruhe (Germany, F.R.). Inst. fuer Systemtechnik und Innovationsforschung). 1979. 95p. (In German). NTIS (US Sales Only), PC A05/MF A01.

The aim of the study was to devise a relatively easily applied mathematical model for the utilization of solar energy in private dwellings and to find a simple method of calculation for use with solar installations and to examine its relevance and accuracy with respect to the design and optimization of solar installations in every-day practical situations without resort to large scale mathematical models. An inventory of various concepts for the practical design of solar domestic hot water and space heating installations is compiled. Mathematical models for the computer-aided, reliable design of solar installations based on a variety of concepts and dimensions are studied. In the search for suitable methods for the simplified calculation of solar installations, the f-chart method was examined for accuracy and applicability by means of the simulation model. It was found that for a fixed system configuration the f-chart method gives good results, provided that certain limits within which the more important system parameters are allowed to vary are not exceeded. (These are: collector area, collector losses, collector adjustment, storage capacity, heat requirement for domestic hot water supply and/or space heating.)

10632 (LA—8450) Solar energy research at LASL. Progress report, October 1, 1979-March 31, 1980. Reisfeld, S.K.; Neeper, D.A. (comps.). (Los Alamos Scientific Lab., NM (USA)). Nov 1980. Contract W-7405-ENG-36. 58p. NTIS, PC A04/MF A01.

The work of Q-11, the Solar Energy Group of the Los Alamos Scientific Laboratory, is documented for October 1979 through March 1980. Q-11 conducted passive solar heating research and collector testing. In addition, the group provided technical support to the Department of Energy, Office of Solar Applications for Buildings, for both solar collector and passive system development.

10633 (MCR—80-640) Modification A005: SOLCOST support and maintenance. Final technical report. (Martin Marietta Corp., Denver, CO (USA)). Oct 1980. Contract AC02-76ET20108. 41p. NTIS, PC A03/MF A01.

The FY80 activities performed by Martin Marietta Aerospace on the SOLCOST Solar Heating and Cooling Analysis project are described. Five tasks were addressed on this effort, including (1) development of the SOLCOST-PASSIVE program, (2) development of the SOLCOST-PHOTOVOLTAIC program, (3) SOLCOST validation, (4) process heating modifications, and (5) ongoing support of the SOLCOST software and its installation on five national timesharing networks. The passive solar heating capability in SOLCOST is based on the Los Alamos Solar Load Ratio (SLR) method. The SLR correlations were derived from hour-by-hour simulations made with the PASOLE computer program developed by the Los Alamos Solar Group. The SOLCOST-PASSIVE implementation of the SLR method predicts the solar savings fraction and required auxiliary heat for Trombe and water wall mass storage systems and direct gain buildings. Combinations of these approaches can be evaluated by simply specifying the parameters for each feature. The program also includes a powerful economic analysis, which accounts for federal and state solar tax incentives. The SOLCOST-PHOTOVOLTAIC program is an interac-

tive computer design tool intended for use by non-solar specialists to predict the long term performance of photovoltaic systems. A life cycle cost analysis is included in the program along with the ERDA-EPRI standard economic analysis. SOLCOST-PV currently can evaluate flat plate arrays and concentrating arrays which use Fresnel lenses and passive cooling.

10634 **(SAND—80-1869C) Solar enhanced oil recovery: a potential early market for industrial solar energy.** Bergeron, K.D.; Dugan, V.L. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 12p. (CONF-801203—5). NTIS, PC A02/MF A01.

From National conference on renewable energy technologies; Honolulu, HI, USA (7 Dec 1980).

Enhanced oil recovery and the possibility of using solar energy to replace current methods are discussed. The market potential for solar enhanced oil recovery is explored. (MHR)

10635 **(SERI/SP—721-874) Large resource development projects as markets for passive solar technologies. Final report.** Roze-Benson, R.V. (Early Insights, Golden, CO (USA)). Dec 1980. Contract AC02-77CH00178. 85p. NTIS, PC A05/MF A01.

A basic premise of this study is that large resource development projects provide a major market opportunity for passive solar manufactured buildings. The primary objectives of the work are to document selected resource development projects and identify their potential housing needs and development schedules, to contact resource industry representatives and assess some of the processes and motivations behind their involvement in housing decisions, and to provide passive solar manufactured buildings producers with results of these steps as early initial market intelligence. The intent is to identify not only the industries, location of their planned projects, and their likely worker housing needs, but also the individuals involved in making housing-related decisions. The 56 identified projects are located within 18 states and cover 11 types of resources. The report documents individual projects, provides protections of total worker-related housing needs, and presents overviews of resource development company involvement in the new construction market. In addition, the report profiles three organizations that expressed a strong interest in implementing the use of low-cost passive solar manufactured buildings in resource-development-related activities.

10636 **(SOLAR/0024—80/41) Performance of active solar domestic hot water heating systems. Comparative report, 1979-1980 season.** Cramer, M.A.; Kendall, P.W.; Rosenbusch, J.M.; Weinstein, R.A. (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). 1980. Contract AC01-79CS30027. 249p. NTIS, PC A11/MF A01.

The most recent composite results of analysis performed by Vitro Laboratories of solar hot water heating data for selected hot water sites in the National Solar Data Network (NSDN) are presented. Results presented have been developed on the basis of analysis of instrumented sites monitored through 1979-1980. A total of 45 sites in the National Solar Data Network (NSDN) were examined for this study. Eighteen of these were selected for in-depth treatment because of the availability of valid long term data. System descriptions, schematic diagrams and energy flow diagrams for these 18 sites are presented in Appendices A, B, and C, respectively. (WHK)

10637 **(SOLAR/1001—80/14) Solar energy system performance evaluation: Moulder Corporation, West Greenwood, Indiana, October 1979 through April 1980.** Whitehead, C.Y. (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). 1980. Contract AC01-79CS30027. 74p. NTIS, PC A08/MF A01.

The performance of a single-family home which has 704 ft^2 of air, flat-plate collectors and an 850 ft^3 rock bin buried under the house is discussed. The system was designed to contribute 84% of the space heating and 100% of the water heating. Actual contributions were 17% of the hot water load and 21% of the space heating load. Problems with the systems are described. (MHR)

10638 **(SOLAR/1014—80/14) Solar energy system performance evaluation: Hei Wai Wong, Honolulu, Hawaii, November and December 1979 and April through August 1980.** Cramer, M. (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). 1980. Contract AC01-79CS30027. 76p. NTIS, PC A05/MF A01.

The Hei Wai Wong site is a four-story apartment building in Honolulu, Hawaii. The building is equipped with three hot water solar energy systems with essentially the same design. One of these systems is instrumented for six apartments and a laundry. The instrumented system consists of an array of flat-plate collectors with an area of 807.4 square feet. The collector and storage subsystem consists of a 1230-gallon storage tank mounted on the roof with the bottom of the tank slightly higher than the top of the collector panels. When the sun heats the water in the collectors above the tank water temperature, a thermosiphon current is induced. When the temperature in storage exceeds the temperature of the water in the collectors, the thermosiphon flow ceases. The solar energy system at Hei Wai Wong supplied 98% of the energy required for hot water for the six apartments and the laundry.

10639 **(SOLAR/1043—80/14) Hullco Construction, Prescott, Arizona: solar energy system performance evaluation, October 1979-May 1980.** Miller, P.C.; Pollock, E. (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). 1980. Contract AC01-79CS30027. 88p. NTIS, PC A05/MF A01.

A single-family passive solar residence located in Prescott, Arizona was designed to supply 97% of the heating load. Included in the system is an attached greenhouse, a Trombe wall, rock bin, direct gain floor slab, and secondary storage in the building mass. The actual solar contribution was 91% in this colder than average season. (MHR)

10640 **(SOLAR/2015—80/14) Solar energy system performance evaluation: Kalwall Corporation, Manchester, New Hampshire, October 1979 through May 1980.** Spears, J.W. (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). 1980. Contract AC01-79CS30027. 81p. NTIS, PC A05/MF A01.

The Kalwall Corporation is a commercial warehouse located in Manchester, New Hampshire. The direct-gain passive solar energy system was designed to supply approximately 50% of the annual space heating demand. The addition of roof insulation has resulted in system performance which exceeds these design projections. The structure is equipped with 1750 ft^2 of vertical south-facing glazing and 850 ft^2 of vertical east-facing glazing. The storage system consists of 817,000 pounds of dark-colored concrete in the eight-inch floor slab. Additional storage is in the materials stored in the warehouse. Auxiliary space heating is provided by two liquid-to-air heat exchangers supplied by the building boiler.

10641 **(SOLAR/2029—80/14) Troy-Miami Library, Troy, Ohio solar energy system performance evaluation, November 1979-April 1980.** Dudzik, S. (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). 1980. Contract AC01-79CS30027. 77p. NTIS, PC A05/MF A01.

Performance data for the solar space heating system at the Troy-Miami Library in Troy, Ohio, are presented and analyzed. The solar system utilizes 3264 sq. ft. of Owens-Illinois Sunpak Shaped Reflector evacuated tube collectors and a 5000 gallon underground steel-lined fiberglass water storage tank to heat the 23,000 sq. ft. building. The solar system performance can be briefly summarized: solar fraction, 31%; solar savings ratio, 0.20; conventional fuel savings, 11,421 kWh; system performance factor, 0.29; solar system COP, 2.96. (WHK)

10642 **Air conditioning apparatus utilizing solar energy and method.** Meckler, G. (to Gershon Meckler Assoc). US Patent 4,222,244. 16 Sep 1980. Filed date 7 Nov 1978. vp.

An air conditioning apparatus and method are disclosed. The apparatus includes a chemical dehumidifier which employs an aqueous hygroscopic solution of glycol and a solar energy collector for use in regenerating the solution. Air to be conditioned is circulated through a contactor of the chemical dehumidifier, in contact with cooled glycol solution. Concentrated hygroscopic glycol solution is

circulated from a regenerator to the contactor, while dilute solution is circulated from the contactor to the regenerator. Energy from the solar collector is transferred to facilitate concentration thereof. In one disclosed embodiment energy from the solar collector is also transferred to the generator of heat-powered refrigeration apparatus, E.G., absorption or rankine engine driven refrigeration apparatus. The condenser of the refrigeration apparatus may operate to heat the glycol solution in the regenerator of the dehumidifier and the evaporator may cool the concentrated glycol solution in the contactor and/or may supply chilled fluid to a heat exchanger for cooling the dehumidified air. In a modified embodiment, a diesel engine drives the refrigeration apparatus. Waste heat from the diesel engine either augments the solar energy for regenerating the glycol solution or regenerates desiccant from a second stage of dehumidification.

10643 **Solar pool heater.** Acker, L.C. (to Engineering And Res Assoc Inc). US Patent 4,222,366. 16 Sep 1980. Filed date 21 Jul 1978. vp.

A solar pool heater is defined by a submersible tubular ring attached to the perimeter of a transparent or translucent sheet. Floatation of the heater is obtained through an air bubble captured by the sheet and maintained by the ring. The ring is perforated to permit the entry of water within the ring to induce partial submersion and thereby establish a peripheral seal about the captured air bubble. The submersed ring also prevents overlapping of adjacent heaters and reduces the likelihood of the heaters being blown off the pool by wind. By developing the sheet from material transparent to at least a spectrum of the solar rays, the air space intermediate the sheet and the underlying water surface will provide a "greenhouse" effect to heat the water through direct impingement by the received radiant energy; additionally, radiation of heat from the water will be reduced by the sheet, whereby, the heater not only collects but retains the impinged radiant energy.

10644 **Solar food dryer.** Everitt, S.K. (to Solar Saver International). US Patent 4,221,059. 9 Sep 1980. Filed date 15 Dec 1976. vp.

A box-shaped housing has side and end walls together with a back wall, leaving an opening at its front. A cover of material transparent to sunlight removably closes the front. Inside are a plurality of shelves mounted so as to be tilted at an angle with respect to the end walls. The housing is supported in a stationary position with its back wall tilted backwardly from the top so as to orient the removable shelves substantially in a horizontal position. A plurality of apertures in the housing enable air flow upwardly therethrough.

10645 **Solar heated anaerobic digestor.** Rhoades, D. US Patent 4,221,571. 9 Sep 1980. Filed date 13 Nov 1978. vp.

A solar heated anaerobic digestor is provided, adapted to utilize organic material capable of decomposing to produce methane gas and a liquid fertilizer. The sealed anaerobic digestor is wrapped with a layer of heat absorptive material followed by a series of abutting removable panels of insulative material. Insulative panels may be temporarily removed to expose the heat absorptive material to solar radiation and may be replaced when the solar radiation diminishes. A layer of transparent material wrapped in outwardly spaced relation around the insulating panels is capable of transmitting solar radiation while providing protection against environmental elements. Additional heating means extending into the digestor provide auxiliary heat as required.

10646 **Refrigerant charged solar heating structure and system.** Bottum, E.W. US Patent 4,220,138. 2 Sep 1980. Filed date 24 Jan 1978. vp.

A solar heating system is provided. The heating system comprises a solar collector structure operatively connected to a heat dissipating structure including means for ultimately using the heat energy which the system produces. Refrigerant is used in the system. The refrigerant is boiled in the collector and condensed in the heat dissipating structure to give off heat. A vessel is located below the heat dissipating structure. Liquid refrigerant flows into the vessel and is pumped back to the collector in selected quantities.

10647 **Portable solar cooker.** Way, L.V. US Patent 4,220,141. 2 Sep 1980. Filed date 21 Sep 1978. vp.

A portable solar cooker of the type having an insulated housing with an oven compartment enclosed therein and associated reflector elements is adapted for cooking with the housing and oven compartment in a tilted or level position. When employing only the tilting mode for tracking the sun, reflecting panels are removably attached to the top of the cooker housing. When there is a need to maintain the oven compartment level while tracking the sun during the cooking operation, the reflecting panels are removably mounted on a pivotal frame connected to a telescoping strip assembly which, in turn, is removably mounted on the topside of the cooker housing.

10648 **Active solar and industrial process heat: state of the art.** Starr, S.O. Minneapolis, MN; Mid-America Solar Energy Complex (1980). 13p. (CONF-8009127—2).

From Mid-America solar update conference; Saint Paul, MN, USA (9 Sep 1980).

The primary market opportunities for active systems in the residential and commercial sectors are discussed: swimming pool heaters, domestic hot water supply, and space heating. The opportunities discussed in the industrial sector are: space heating and process heat supply. Solar-assisted heat pumps and salinity gradient solar ponds are reviewed. (MHR)

10649 **Elaboration of Fe-B alloys with high boron concentration.** Armas, B.; ;Combescure, C.; Morales, M. (CNRS, Odeillo, France). pp 1965-1968 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Fe-B alloys were prepared with high boron concentration in a solar furnace by direct melting in order to obtain thermoelectrical materials.

10650 **Teaching the principles of solar energy in the undergraduate engineering laboratory.** Taub, L.J. (State Univ. of New York, Farmingdale). pp 1975-1979 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Instructions systems for teaching the principles of solar water heaters, solar space heaters, and solar-assisted heat pumps are described. (WHK)

10651 **Passive solar design: laboratory science in a liberal arts college.** Holzberlein, T.M. (Principia Coll., Elsah, IL). pp 1980-1984 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A five quarter-hour liberal arts laboratory science course in passive solar design is described in which Bruce Anderson's Solar Home Book served as a reference text for nineteen liberal arts students. Theory included: calorimetry, heat transfer and storage, thermal scaling of test models, earth-sun astronomy, etc. Experiments in Passive Solar Design, published by F.I.R.S.T. in Dow, Illinois served as the laboratory manual for six experiments: Solstice Sunray Cones, Specific Heats of Building Materials, Temperature Stabilization by Thermal Mass, Temperature Stabilization by Insulation, Thermal Swing vs Glazing Multiplicity and Temperature Peaking-time vs Window Orientation. Student-couples' projects included solar home design, model construction, and computer assisted thermal analysis. Student evaluation is also discussed.

10652 **Experiments for teaching solar energy concepts in chemistry.** Cantrell, J.S. (Miami Univ., Oxford, OH). pp 1994-1998 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Four experiments have been developed to be used in chemistry, physics, and general science labs as experiments to supplement the normal offerings of these traditional programs at levels from high school to college. In addition, the author has successfully

given them as a part of a laboratory course in the Master's Degree program of the Institute of Environmental Science at Miami University. These experiments are entitled: Solar Calorimetry, Measuring the Power and Energy From the Sun, Concentrating Collectors-Fresnel Lens Experiment, and A Silicon Solar Cell Experiment. The Solar Calorimetry Experiment has been given to over 500 students with about a 90 to 95% success in terms of student results being reasonable and the student's perception of a successful experience.

10653 **To market, to market: experience in solar design for mass production housing.** Juchau, B. (Tandem, Inc., Davis, CA). pp 2073-2076 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The efforts of a moderately-large building firm to design and refine a solar radiant floor slab heating and nocturnal cooling system are described. Cost-efficient installation and operation are basic to the system. The design process towards these goals is described from inception to final sale and service. This central California developer's privately funded, self-motivated work in innovative solar design is aimed at the mid-priced housing marketplace. Five pairs of homes, each with progressively more sophisticated architectural and mechanical design, define the chronology of the refinement process. The culmination is large-scale solar home and apartment construction utilizing the final system design. The firm intends to profitably market a practical solar package for its buildings and those of other developers. Many problems were encountered. Among them were material and labor costs and availabilities, component breakdowns, and poor performance. The resolution of these problems, yielding a simple, saleable, mass-production solar heating/cooling system, is described at length.

10654 **Solar market development and changing consumer acceptance.** Glesk, M.M.; Heiko, L.K.; Kernan, P.A. (Arthur D. Little, Inc., Cambridge, MA). pp 2085 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

10655 **Economics of solar hot water heating in multifamily units.** Zien, H.B. (Zien Mechanical Contractors, Milwaukee, WI). pp 2107-2110 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979)

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Solar economic studies based on payback and life cycle costing generally ignore the impact of income taxes. Yet taxes are a major motivator for real estate developers. Therefore, it is essential that solar analyses include the effects of tax policy if developers are to be convinced that the investment is justified. The feasibility of a solar hot water heating system in a multifamily apartment complex using an income tax analysis is examined. The results indicate that conventional solar analyses can significantly understate the economic benefits of an investment in a solar system to a real estate developer.

10656 **Evaluation of the prospects for residential solar heating, cooling and hot water production in the United States.** Bruno, R. (Phillips Research Labs., Aachen, Germany); Duff, W.S. pp 2131 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

10657 **Cost and performance evaluation of passive solar systems.** Gorman, R.; Heitner, K.L.; Mehta, K.H.; Molander, A.B.; Moritz, P.S.; Thomas, C.J. (TRW Energy Systems Group, McLean, VA). pp 2132-2136 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

TRW has generalized and computerized the basic LASL methodology for evaluating passive solar systems. The program designs a variety of building configurations and allows optimum designs to be selected. Cost and performance data for desirable solar systems are examined in several major US climate - insolation regimes. Results show well over half of all heating energy can be saved in most climate areas with optimal passive solar systems.

10658 **Effect of an auxiliary load management strategy on solar system performance.** Newell, T.; Swanson, S.; Boehm, R. (Univ. of Utah, Salt Lake City). pp 2143-2147 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Electric utilities typically have peaking problems caused by seasonal and time-of-day variations in demand. This report presents the results of an analysis performed to determine whether solar systems could be used for electric utility load management. A straightforward strategy was devised that consisted of adding heat energy to the solar system heat storage during off-peak (night time) hours, bringing the sensible heat storage up to a controlled temperature level. This strategy was then investigated by means of a detailed computer simulation of system performance, using Salt Lake City weather data. The elevated storage temperature due to the load management led to a reduction in the solar system performance, which was compensated by a shift of the utility load to off-peak times. The tradeoff looks quite favorable as a large shift to off-peak energy usage is accompanied by only a small reduction in solar system performance.

10659 **Passive, active, and conservation: an energetic and economic analysis.** Palmiter, L. (National Center for Appropriate Technology, Butte, MT); Noll, S. pp 2157-2161 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A detailed comparison is presented of the life-cycle economic and source energy impacts of solar space heating systems in two locations: Albuquerque, New Mexico and Madison, Wisconsin. Two solar system types were studied: a Trombe wall with night insulation (TWNI) and a fan-forced air-collector rock storage system (ACRS). The load collector ratio (LCR) method developed at Los Alamos was used to estimate the system size required to achieve a given solar fraction. Each system was examined at two levels of conservation: a base level meeting all current and anticipated code requirements, and a super-conserving level. Two types of auxiliary were considered: natural gas and electric resistance. Combinations of location, auxiliary type, conservation level, and solar system type produced sixteen distinct case studies. For each case, source energy and economic effects were examined at solar fractions of .20 to .90 in increments of .10. This allowed direct analysis of performance over the full range of solar system sizes. In each of the sixteen cases the system was chosen with the lowest total life-cycle cost. A detailed comparison was then made of the sixteen optimal systems relative to the non-solar base and conservation options.

1410 Solar Collectors And Concentrators

10660 **(DOE/JPL—1060-37) Status of JPL's experience with thin 7809 glass for solar energy applications. Report No. 1.** Bouquet, F.L. (Jet Propulsion Lab., Pasadena, CA (USA)). 1 Oct 1980. Contract AC02-77CH00178. 31p. (JPL-PUB—80-96). NTIS, PC A03/MF A01.

Through an agreement with DOE, the Solar Energy Research Institute, Golden, Colorado, has supplied JPL with a shipment of advanced, high-transmittance glass for solar thermal power applications. The glass, Corning Code 7809, is planned for use in advanced parabolic dish designs. The results of both mirror and glass inspection are documented. Surface and bulk defects are identified as well as the number broken or chipped during shipment and handling. Of the panels received, the thicker 1.5-mm (0.060-in.) glass exhibited a smaller breakage rate than the thin 1.0-mm (0.040-in.) panels.

10661 **(DOE/NASA/TM—82395) Development and testing of heat transport fluids for use in active solar heating and cooling systems: final report.** Parker, J.C. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Jan 1981. Contract AI01-76CS31037. 41p. NTIS, PC A03/MF A01.

The final results of the additional development work on heat transport fluids for use with active solar heating and cooling systems are summarized. The intended use of the final report is discussed, the deliverable end items are described, program objectives are listed, and means of accomplishment and problems encountered during testing are covered. It is shown that a certain product tested is marketable and is recommended as being suitable for public use.

10662 **(SAND—80-1964/3) Midtemperature solar systems test facility predictions for thermal performance of the Acurex solar collector with FEK 244 reflector surface.** Harrison, T.D. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 22p. NTIS, PC A02/MF A01.

Thermal performance predictions are presented for the Acurex solar collector, with FEK 244 reflector surface, for three output temperatures at five cities in the United States.

10663 **(SAND—80-7158) Thermally formed half-parabola glass panels. Final report.** (Ford Aerospace and Communications Corp., Palo Alto, CA (USA). Western Development Labs. Div.). Jan 1981. Contract AC04-76DP00789. 59p. NTIS, PC A04/MF A01.

Thirty-two parabolic prototype panels of Ford Powerlite Plus low-iron glass (.090" thick) were fabricated at the Glass Division's Glass Technical Center. In addition, Corning 0317 fusion glass (.058" thick) was supplied by Sandia Laboratories, and 8 panels were fabricated on a best efforts basis. Each panel contour was a half-parabola of one meter aperture (total trough aperture two meters) with a rim angle of 92° and a focal length of 0.48 meter. The width of each panel was 1.2 meters (48 inches). The half-parabola troughs fabricated under this contract were more complex than typical automotive parts, such as windshields, in that precise control of the entire panel surface contour was required. The present windshield peripheral forming ring concept was modified by the addition of an internal egg-crate grid to produce the forming fixture for required panel contour. Utilizing automotive practice, tooling masters and tooling aids were accurately fabricated. The bending technique is essentially a gravity sag process. Panel inspection measurements were made with the contour gage mechanical tooling and with zebra board reflective optical techniques. These measurements allowed on-line evaluations of the forming procedures and incorporation of processing changes. The final panel contour accuracies were determined by laser measurements. The manufacturing analysis included: (1) manufacturing process selection, (2) manufacturing facilities and tooling expenditure estimates, and (3) directional product pricing assuming annual collector panel surface and markets of 10,000, 1,000,000, and 50,000,000 square feet.

10664 **(SERI/TR—631-716) Yearly average performance of the principal solar collector types.** Rabl, A. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1981. Contract AC02-77CH00178. 56p. NTIS, PC A04/MF A01.

The results of hour-by-hour simulations for 26 meteorological stations are used to derive universal correlations for the yearly total energy that can be delivered by the principal solar collector types: flat plate, evacuated tubes, CPC, single- and dual-axis tracking collectors, and central receiver. The correlations are first- and second-order polynomials in yearly average insolation, latitude, and threshold (= heat loss/optical efficiency). With these correlations, the yearly collectible energy can be found by multiplying the coordinates of a single graph by the collector parameters, which reproduces the results of hour-by-hour simulations with an accuracy (rms error) of 2% for flat plates and 2% to 4% for concentrators. This method can be applied to collectors that operate year-around in such a way that no collected energy is discarded, including photovoltaic systems, solar-augmented industrial process heat systems, and solar thermal power systems. The method is also recommended for rating collectors of different type or manufacturer by yearly average performance, evaluating the effects of collector degradation, the benefits of collector cleaning, and the gains from collector improvements (due to enhanced optical efficiency or decreased heat loss per absorber surface). For most of these applications, the method is accurate enough to replace a system simulation.

10665 **(UCID—18900) World activity in solar ponds.** Dorn, D.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Jan 1980. Contract W-7405-ENG-48. 7p. NTIS, PC A02/MF A01.

The United States and Israel appear to be the only two countries actively developing solar salt-gradient pond technology, which uses the pond water both as a direct absorber of solar energy and as a storage medium for the thermal energy collected. This note presents current US pond projects and past, present, and future Israeli pond projects. Israel, which is clearly leading in the development, has brought its research to a point considered near commercial and is beginning to market the technology in other countries.

10666 **(UCLA-ENG—7971) Model, tests and optimization of flat plate solar collectors, with emphasis on sinusoidal honeycomb.** McMurrin, J.C. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Oct 1979. Contract FG03-76CS31084. 418p. NTIS, PC A18/MF A01.

Thesis.

An exact solution is obtained for a one-dimensional nonlinear resistance network model of flat plate solar collectors with an arbitrary number of cover glasses and honeycomb structures. The models of Hottel, Whillier and Bliss and of Buchberg and Roulet are shown to be special cases of the solution. The model and specific resistance formulations are validated by tests on nine collectors, including two with sinusoidal-celled glass honeycombs. Radiation and convection properties for a range of sinusoidal honeycomb geometries and materials are estimated from existing data. Sinusoidal honeycomb geometry and cover spacing of conventional collectors are optimized analytically with and without economic considerations. Performance sensitivity of honeycomb and conventional collectors to environmental and operating conditions is analyzed.

10667 **Ridged surface solar heater.** Farber, J. US Patent 4,222,807. 16 Sep 1980. Filed date 16 Oct 1978. vp.

A solar heater for water or similar fluids comprises extruded semi-rigid plastic panels containing a plurality of adjacent tubular channels adapted to conducting fluid longitudinally through the interior of the panel from a transverse inlet manifold to a transverse outlet manifold. Flow-restricting passages between the manifolds and channels tend to equalize the flow rates through each channel. Integral with the upper surface of the panels is a plurality of parallel, longitudinally-disposed , triangular cross-section ridges adapted to absorbing solar energy. Solar energy unavoidably reflected from the plane surfaces of the ridges is partially absorbed by adjacent ridge surfaces, increasing the energy absorption efficiency of the panels.

10668 **Solar energy collection apparatus and system.** Ameduri, G.J.; Rost, D.F. (to General Extrusions Inc). US Patent 4,222,368. 16 Sep 1980. Filed date 22 Dec 1977. vp.

A solar energy collection apparatus has a reflector for reflecting the rays of sunlight incident thereupon to, and concentrating them upon, an absorber. Mounting blocks insulate and position the reflector and absorber with respect to each other and to support struts. Due to a wide angle of acceptance of the apparatus, the rays of the sun are collected for a substantial part of a day as well as for a period of time of many days or months. Additionally, the reflector-absorber assembly can be readily adjusted for other periods of time throughout the year by changing the length of the support struts.

10669 **Nontracking concentrating solar collector.** Degeus, A.M. US Patent 4,222,370. 16 Sep 1980. Filed date 17 May 1978. vp.

A nontracking concentrating solar collector is provided in which a series of parallel parabolic reflector segments reflective on

both sides thereof are disposed with their focal points lying in a plane which is at approximately a right angle to the angle of incident solar radiation which is received in the space between the upper ends of the reflector segments. The length of the reflector segments is selected so that the incident radiation is reflected back and forth between the segments until an even numbered reflection, preferably either the fourth or the sixth reflection, emerges downwardly from between the reflector segments in a narrowed beam which is received by a solar collector. Preferably, the collector is a tube carrying a heat transfer medium which is positioned beneath the reflector segments other than the first segment in the series, and paralleling said segments, and a secondary reflector is positioned beneath the tubes to concentrate the reflections emerging from the reflector segments upon the tubes.

10670 **Solar energy collector.** Heath, G.F. US Patent 4,222,371. 16 Sep 1980. Filed date 4 Oct 1977. vp.

A solar energy collector that includes a number of elongate, hollow, metallic, tubular members of such transverse cross section that when disposed side-by-side they define a number of spaced longitudinal apertures through which solar energy rays are directed by lens systems into a number of elongate cavities having dark or black surfaces. The hollow members have the ends so connected to one another that water or other fluid flowing to the collector sequentially traverses the longitudinal passages in the tubular members prior to discharging from the collector. During the flow through the passages heat is transferred to the water or other fluid flowing therethrough from the heated cavities. The solar rays directed by the lens system into the cavities may, if desired, be used to activate photoelectric cells , and the light be transformed directly into electricity.

10671 **Solar collector assembly.** Bogatzki, H. US Patent 4,222,372. 16 Sep 1980. vp.

Individual collector cells are fitted together in series along a heat transfer medium tube. The cells have a cylindrical housing with mating interconnecting flanges at the ends, through which the tube also passes. The flanges may have sealing gaskets. The housing has a transparent front side and a reflective back side. The cross-sectional configuration of the front is arcuate, while that of the back is parabolic. The cells are fixed with respect to the tube axis, but can rotate about it to follow the sun. Parallel cell rows can be interconnected to rotate together. Interconnected, articulated cell rows are disclosed as a removable cover for a swimming pool

10672 **Ceramic solar collector.** Davis, M.A. US Patent 4,222,373. 16 Sep 1980. Filed date 26 Jul 1977. vp.

In abstract a preferred embodiment of this invention is a flat plate type solar collector constructed of specially prepared ceramic material and designed to give maximum heat exchange with either liquid or gaseous fluids.

10673 **Pond sealing.** Jefferson, G.; Laborde, M. (to Corporacion De Fomento de la Produccion (Chile); Corporation De Fomento De La Produccion). US Patent 4,222,685. 16 Sep 1980. Filed date 20 Mar 1979. vp.

A method of providing a substantially impermeable lining to the bottom of an earthen pond using native soil. Such soil is classified and formed into a slurry containing fine particles of predominately five or less micron size. The pond bottom is covered with a first layer of the slurry which is allowed to dry to a point where large crack patterns develop. The cracks are filled with a second layer of the slurry. More layers may be applied to form a final lining having the desired permeability for the particular application.

10674 **Solar tracking device.** Dorian, M.E.; Nelson, D.H. (to American Solar Systems Inc). US Patent 4,223,214. 16 Sep 1980. Filed date 9 Jan 1978. vp.

An improved solar tracking arrangement is provided for directing a solar energy collector to face the sun. An electrical control mechanism is provided to detect misalignment of the collector as the sun traverses in relative movement across the sky. When the misalignment exceeds an adjustable limit of tolerance, the tracking system moves the collector to an orientation slightly in advance of the current position of the sun by an amount equal to the limit of tolerance. A threshold light level is required to activate the tracking system, and differential photosensors are employed, the composite signals of which compensate for variations in ambient light level so that the amount of surrounding illumination of the environment does not effect the preset limit of tolerance. The tracking system includes east and west limit switches, which reorient the collector to an eastward facing direction at the end of each day. A high temperature cut off is provided to direct the collector away from the sun when the operating temperature of the collector exceeds a predetermined limit of safety. For self-contained operation, photovoltaic cells are mounted on the collector to provide electricity for the tracking system.

10675 **Solar collector assembly.** Murphy, J.A. US Patent 4,221,208. 9 Sep 1980. Filed date 28 Nov 1978. vp.

A solar collector assembly includes shingles which have integral tubes projecting therefrom, and which are mounted in overlapping parallel array. Mounting brackets for the shingles are engaged on roof rafters or the like, and interlocked light transmissive plates overlie the shingles. The plates are also engaged with shingle components. A special fitting for the tube ends is provided.

10676 **Solar heat exchange panel.** Thorne, N.J. US Patent 4,221,209. 9 Sep 1980. Filed date 24 Apr 1978. vp.

Heat-absorbing bars having a v-shape are placed parallel to one another in a spaced relationship over a reflective surface. Sunlight strikes the bars on their exposed surface and also off the reflective surface against the underside of the bars. Water tubes may also be used.

10677 **System and method for collecting energy from the sun.** Cvijanovich, G.B. (to Heliotherme Inc). US Patent 4,221,210. 9 Sep 1980. Filed date 1 Aug 1977. vp.

The system for collecting energy from the sun is composed of a transparent panel having a plurality of channels open at both ends, a liquid capable of absorbing about 85-100% of the energy from impinging rays of the sun per centimeter thickness of the liquid, means for introducing the liquid into the panel and means for removing the liquid from the panel. Energy from the sun is collected by circulating the liquid capable of absorbing 85-100% of energy from impinging rays of the sun in a transparent panel which is exposed to the sun per centimeter thickness of the liquid. Heat absorbed by the circulating liquid may be transferred through the medium of heat exchanger and used to heat a building, for hot water and the like.

10678 **Cover pane for solar collectors.** Neumann, S. US Patent 4,221,466. 9 Sep 1980. vp.

A cover pane for a solar collector includes a plurality of solar energy focusing lenses arranged in longitudinal rows with the lenses within adjacent, alternative rows longitudinally offset so as to facilitate the impingement of the solar energy upon the lenses and to prevent lenses within any one row from interfering with the transmission of the solar radiation to the lenses within another row. The columnar arrangement of the lenses also facilitates self-cleaning of the cover. Each lens element is substantially ovoid or egg-shaped, as seen from a plan view, with the elongated east and west sidewalls serving to maximize early morning, evening, and winter solar radiation collection. In addition, the sidewalls are steeply sloped toward a plane normal or perpendicular to the cover base, while the front walls of the lenses are somewhat flattened. These sloped walls serve to maximize the collection of the solar energy as the sun traverses its trajectory during the solar day, as well as during the winter months when the trajectory of the sun is lower than that during the summer as known in the northern hemiphere.

10679 **Periodic solar collector.** Alkasab, K.A. US Patent 4,220,135. 2 Sep 1980. Filed date 2 Jan 1979. vp.

The present invention relates to a solar energy collector which includes a housing which has two solar absorption panels on the exterior surface thereof and an energy collection chamber therein. A motor is coupled to the housing for moving the solar absorption panels between a first position, characterized as being illuminated with solar radiaton, and a second position, characterized as being in thermal communication with a heat transfer fluid contained within the energy collection chamber of the housing. A heat transfer device is immersed in the primary fluid within the energy col-

lection chamber for removing thermal energy therefrom. A control system is coupled to the motor for moving the solar absorption panels between the first and second positions in a transient unsteady mode.

10680 **Solar energy collector.** Penney, R.J. US Patent 4,220,136. 2 Sep 1980. Filed date 13 Sep 1978. vp.

A sun tracking solar energy collector assembly having both a longitudinally extending flat plate absorber and a tube absorber spaced from and extending longitudinally generally parallel to the flat plate absorber. In one form a parabolic reflector focuses direct rays of solar radiation on the tube absorber and directs diffused rays of solar radiation onto the plate absorber. In another form a fresnel lens plate focuses direct rays of solar radiation on the tube absorber and flat reflector surfaces direct diffused solar radiation passing through the lens plate onto the plate absorber. In both forms a fluid is first heated as it circulates through passages in the flat plate absorber and then is further heated to a higher temperature as it passes through the tube absorber.

10681 **Solar energy collecting system.** Tesch, A.R.; Tesch, S.T. US Patent 4,220,137. 2 Sep 1980. Filed date 18 Sep 1978. vp.

The solar energy collecting system of the preferred embodiment of the present invention includes two sets of louvers, adapted for being mounted in a window opening. A first set of louvers is mounted vertically, each louver having a pivot point at its top and its bottom. This set of louvers is controlled for reflecting infra-red rays of the sun toward the inside of the building in which the system is installed. The second set of louvers is mounted horizontally and usually interiorly of the first set. The horizontal louvers also include pivot points at their ends and a control system is provided for reflecting and focusing the rays reaching their surfaces to an energy collector. Various features of the present invention which are described herein include constructing one or both sets of louvers from insulating material so that the louvers can be closed to reduce heat loss from the structure, placing the energy collector either inside or outside of the structure or having collectors both on the inside and on the outside to permit a choice of where the rays are focused, various operating modes for the dual-louver system, and various shapes which can be employed for the louvers.

10682 **Solar panel shielding.** Ramsden, J.B. US Patent 4,220,139. 2 Sep 1980. Filed date 15 Sep 1978. vp.

A solar energy collector is disclosed. The collector has a frame , a window and an absorber enclosed by the frame and a combined heat trapping and heat shielding arrangement between the window and the absorber. The trapping and shielding arrangement consists of a series of vanes extending from side to side of the frame and , in a heat trapping position, from the window to the absorber. In a heat shielding position, the vanes overlap when projected upon the plane of the absorber so that incident radiation must pass through plural vanes before reaching the absorber.

10683 **Solar receiver.** Francia, G. US Patent 4,220,140. 2 Sep 1980. Filed date 27 Feb 1978. vp.

The invention provides a solar receiver able to transform the incident solar energy into a thermal energy for heating a suitable fluid up to the temperatures required by the present thermoelectric plants and water dissociation processes.

10684 **Spectral selectivity of composite media.** Sievers, A.J. (Cornell Univ., Ithaca, NY); Trotter, D.M.; Buhrman, R.A.; Craighead, H.G. pp 1878-1882 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The fundamental limits associated with the spectral selectivity of composite media are identified. Results show that $\epsilon_{H} \geq 0.1$ at 750°K regardless of what composite film-metal substrate combination is fabricated.

10685 **Problems and promise of black chrome as a selective absorber.** Ignatiev, A. (Univ. of Houston, TX). pp 1883 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

10686 **What is black chrome.** Driver, P.M. (Univ. of Western Australia, Nedlands). pp 1887-1891 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Although black chromes have been produced for several years, little is known of their composition and structure, or of the interrelationships between these properties, the deposition mechanisms, and the optical and physical properties. The reasons for this are twofold. The first is that black chrome is not a single material but a class of dark coatings containing substantial quantities of chromium, and with widely varying structures. The second is that standard thin film analysis techniques are severely limited in their quantitative accuracy when used to study black chromes. 51 references.

10687 **Improvement of optical reflectance of homogeneous interference film for solar absorber by texture control.** Ohno, J.; Shindoh, Y.; Oka, J.; Okada, H. (Nippon Steel Corp., Kawasaki, Japan). pp 1902-1906 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

In evaluating the optical properties of selective film, special attention should be paid to the wavelength λ_r at which the reflectance spectrum starts to rise (hereinafter referred to as the rise wavelength). The thermal efficiency of collectors operated so as to obtain a fluid temperature of above 70°C can be considerably increased by optimizing the rise wavelength. The following are essential for the control of the rise wavelength λ_r: selection of principal components of the film so as to insure optical matching with the substrate; and control of chemical composition so as to change the optical constant of the film in its thickness direction. Based on the results of computer simulation, the transverse method has been developed for controlling two parameters, the absorptance in the visible region, α, and the rise wavelength λ_r independently. This method was applied for the improvement of selectivity of colored stainless steel which has found wide application as a good absorber. It has been hitherto impossible to optimize the rise wavelength λ_r of the colored film because of its homogeneous structure. An excellent selectivity was obtained in laboratory tests by the texture control of colored film.

10688 **Spectral selective properties of nickel carbide with varying carbon content: interpretation in terms of electron gas.** Sikkens, M.; Francken, J.C. (State Univ. of Groningen, Netherlands). pp 1907-1911 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The mechanism of spectral-selective absorption in dc reactively sputtered nickel carbide has been studied by reflectance and transmittance measurements, electron spectroscopy and dc resistivity measurements. The carbon content and dc resistivity is found to increase almost continuously with the partial methane pressure used in sputtering. The optical properties can be explained in terms of the Roberts model in which both free and bound electrons contribute to the dielectric constant. It is shown that the major contribution to the selectivity originates from the conduction (free) electrons. The dc resistivity calculated from the model-parameters agrees reasonably well with experiments.

10689 **Production and properties of selective surfaces coated onto glass tubes by a magnetron sputtering system.** Harding, G.L.; Window, B.; Horwitz, C.; Collins, A.R.; McKenzie, D.R. (Univ. of Sydney, Australia). pp 1912-1916 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A cylindrical magnetron sputter coater has been constructed for deposition of selective absorbing surfaces onto batches of 1.5 m

long glass tubes. A selective surface consisting of reactively sputtered mixed iron chromium and nickel carbides overlayed on sputtered copper on glass has been used to evaluate the properties of the coater. Absorptances, emittances and ageing properties of selective surfaces produced by the coater are discussed.

10690 **Effect of corrosion on selectivity of electrodeposited black chromium with and without nickel underlayers.** DiBari, G.A. (International Nickel Co., Inc., Suffern, NY);Turillon, P.P. pp 1917-1921 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

In the case of electrodeposited metallic and metal oxide coatings having requisite absorptance and emittance properties, galvanic corrosion of the coating/absorber combination may limit the life of the system. Corrosion of the coating with accumulation of corrosion products may conceivably alter the characteristics of the selective coating. The work in progress determined that corrosion affects the selectivity of black chromium coatings electrodeposited on steel, copper, and aluminum to a greater extent when electrodeposited nickel underlayers are omitted.

10691 **Selective electrodeposited chromium black coatings: optical properties, selectivity model.** Lafait, J.; Berthier, S.; Behaghel, J.M. (Universite Pierre et Marie Curie, Paris, France). pp 1922-1925 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Chromium black coatings electrodeposited on nickeled steel or copper substrates exhibit selective optical properties (a = 0.97; e = 0.12), thermal stability and mechanical properties required by photothermal conversion of solar energy below 250°C. Selectivity variations of the coatings prepared with different deposition durations are explained in relation to structure and composition variations. Optical properties of the best selective coatings are presented: hemispherical reflectivity, scattering... A complete quantitative characterization of these coatings has shown surface roughness and inhomogeneous volume structure: Cr metallic inclusions of variable density in Cr_2O_3 matrix. A model for calculating the optical reflectivity is developed, using inhomogeneous medium theories and taking into account the above characterizations. The agreement of these models with experiment is discussed and a qualitative explanation of the selectivity is proposed in this line.

10692 **Photoacoustic determination of absorptance and emittance of solar selective coatings.** Yun, S.I. (Busan National Univ., Korea). pp 1926-1930 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A new approach to the study of radiation characteristics of solar selective coatings is reported. When chopped light impinges on a solid in an enclosed cell, an acoustic signal is produced and detected by a sensitive microphone. This photoacoustic effect is the basis of the new approach. The design and performance characteristics of a photoacoustic spectrometer suitable for recording absorptance and emittance spectra of the solar selective coatings are reported. The dependence of photoacoustic signal on various experimental parameters is explored and some of its usefulness and limitations of the photoacoustic spectrometry in determining absorptance and emittance of the prepared sample has been made. For comparison, both absorptance spectra obtained by photoacoustic technique and conventional Gier-Dunkle reflectometer are reported. A calibration procedure for the photoacoustically determined absorptance and emittance is also discussed.

10693 **Corrosion protective transparent polymer layers with low thermal emissivity on selectively absorbing surfaces.** Reiss, H. (Brown, Boveri & Cie Ag, Heidelberg, Germany). pp 1931-1934 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Selectively absorbing surfaces such as black nickel and black chrome improve the thermal properties of solar collectors over many years of operation if they are stable against corrosion, abrasion, and elevated temperatures. The Black Nickel Ni-Zn-S complex can be electroplated easily. However, the obvious degradation when exposed to even moderate corrosion test conditions has frequently excluded this coating from applications in regions of moist climate. The absorption properties of black nickel can be understood as those of a multilayer interference filter. A further interference layer coating with a low index of refraction should be suitable for the black nickel surface and fit in the already existing absorber stack. This coating constitutes simultaneously a protective anti-corrosion film and works in an anti-reflective manner if it is thin enough over the whole visible and IR-spectral range of absorbed and reemitted radiation. Black chrome exhibits both excellent optical properties and corrosion resistance. However, its absorption coefficient decreases noticeably if a thin porous layer of dendritic structure (a light trapping surface) is removed, e.g. by wiping or touching during transport. Due to the manifold physical absorption process of black chrome (semiconductor filter and resonance scatterer) and the diffuse surface morphology, a further protective layer will hardly constitute an antireflection coating. But black chrome's sensitive outer layer could effectively be protected against mechanical damage if again the additional coating is thin enough to be completely transparent.

10694 **Vacuum preparation of antireflecting glass.** Horwitz, C.M. (Univ. of Sydney, Australia). pp 1935-1938 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Vacuum techniques for (a) increasing glass transmittance and (b) increasing selective absorptance on glass substrates are described. The first is a reactively sputtered silicon film which appears to have high porosity and which has good antireflecting properties. This film can then be reactively sputter-etched to form a graded layer with high transmittance, albeit with high scattering at short wavelengths. The second is a reactively sputter-etched surface which, when overcoated with a copper layer, has given excellent solar-selective performance. It is anticipated that these processes will be especially useful in vacuum tubular collectors.

10695 **Radiative selectivity and the oxidation of stainless steels.** Sharma, V.C. (Univ. of Benin, Benin City, Nigeria); Hutchins, M.G. pp 1940-1944 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A comparison of spectrally selective surfaces formed by both chemical and thermal oxidation of 300 series stainless steels has been made. The optical properties, solar absorptance and thermal emittance, have been measured and the compositions and growth of the surface oxides have been studied using Auger electron spectroscopy. A dark blue, chemically-oxidized surface was found to have the most favorable combination of radiative properties, though further development to produce higher solar absorptance is needed for both chemically and thermally produced surfaces.

10696 **Absorptance and emittance measurements on AlPbS and Zn dust selective surfaces.** Gupta, B.K.; Tewari, F.K.; Thangaraj, R.; Mathur, S.S.; Agnihotri, O.P. (Indian Inst. of Tech., New Delhi). pp 1945-1949 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Selective black paint coatings have been prepared by coating reflective metal particles with a layer of selective black material and two layer Al-PbS coatings have been produced by a chemical deposition process. The solar absorptance of CuO/sub 1-x/ deposited zinc dust coatings is approx. equal to 0.95 and emittance is approx. equal to 0.4. The Al-PbS coatings are stable at room temperature and have good adhesive properties. When cycled between room temperature and 120°C, the coatings suffer no change in their

room temperature spectral absorptance. The coatings have high absorptivity in the solar spectral region approx. equal to 0.93 and low emittance in the infrared region (approx. equal to 0.21). The ultraviolet irradiation in air caused complete photooxidation of the sulfide to sulfate. The stagnation temperatures of the solar selective surfaces were measured by enclosing 30 cm x 30 cm piece in a wooden enclosure insulated with glass wool in a maximum solar flux of 80 mW/cm². With zinc dust coatings, the improvement in the collector efficiency which is the ratio of the temperature increase above the temperature of the standard black panel and the temperature increase of standard black panel above the ambient temperature is estimated to be around 11 percent. The process is potentially a low cost for large scale application in solar photothermal conversion.

10697 **Ion implanted materials as selective absorbers for photothermal solar energy conversion.** Chassagne, G.; Delmas, A.; Treilleux, M. (Universite Claude Bernard, Villeurbanne, France). pp 1950-1954 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Composite materials are produced by implantation at room temperature of alkali metal ions (K^+, Li^+, Na^+) in magnesium oxide single crystals. Thermal treatment precipitates metal aggregates in implantation zone. These precipitates are observed by electron microscopy. The optical properties of these composite materials, principally MgO : Na, are studied with consideration given to their applicability as selective solar energy absorbers.

10698 **Nickel pigmented anodic aluminium oxide for selective absorption of solar energy.** Granqvist, C.G. (Chalmers Univ. of Tech., Gothenburg, Sweden); Andersson, A.; Hunderi, O. pp 1955-1959 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Spectrally selective surfaces on Al metal sheets were prepared by dc anodization in dilute phosphoric acid followed by black coloration via ac electrolysis in a bath containing $NiSO_4$. These coatings had good durability, as found from several accelerated tests. The optical performance was studied by recording of hemispherical reflectance or specular reflectance in conjunction with diffuse light scattering. From these results, a solar absorptance of 0.93 to 0.96 was extracted and a corresponding thermal emittance of 0.10 to 0.20. The structure of the coatings was investigated by scanning electron microscopy on fractured specimens, Auger electron spectroscopy combined with depth profiling by sputtering, and atomic absorption analysis. Based on this information, a multilayer model was formulated, its most conspicuous feature being a sheath near to the Al interface comprised of metallic Ni particles in an Al_2O_3 matrix. The optical properties of this layer were described by the Bruggeman theory. This formulation, together with a matrix technique to account for the multilayer configuration, was capable of giving quantitative agreement with the measured spectral reflectance, especially when reasonable estimates of surface roughness and of particle shape and orientation were invoked.

10699 **Survey of the current solar collector product literature.** Hofmann, P.L. (Battelle Memorial Inst., Columbus, OH). pp 2006-2009 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The results of a recent survey of the solar collector product literature is reported. Current price and efficiency data are listed and some brief comparisons with historical cost and price trends are made.

10700 **Simulation of partially and fully tracking flat plate collectors in northern latitudes.** Simonson, J.R. (City Univ., London, England). pp 2214-2218 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A computer program has been written to calculate the incident energy available on the surface of a flat plate collector, using hourly measured radiation data for horizontal surfaces at Kew, (51°28′ North). An optimum annual incidence of 1004 kWh/m² was calculated for a collector of 31° slope, pointing due south with normal ground reflectance. The program was modified to consider partial and full tracking. In partial tracking the collector followed the sun's azimuth angle, the slope being fixed. Increases of 19.1 and 20.4 per cent were achieved with partial and full tracking, the small additional increase with full tracking being due to the relatively large amounts of diffuse radiation. Possible upper limits of incident energy with enhanced ground reflection were also calculated. An approximation to partial tracking in which the collector azimuth angle equalled the hour angle, was also considered.

1420 Heat Storage

10701 **(AD-A—086051) Investigation of methods to predict thermal stratification and its effect on solar energy system performance. Special report.** Sliwinski, B.J. (Army Construction Engineering Research Lab., Champaign, IL (USA)). May 1980. 33p. NTIS, PC A03/MF A01.

this report describes a study to identify characteristics which induce thermal stratification in liquid thermal storage, and to evaluate solar energy system performance as a function of the degree of stratification. It was determined that for efficient use of thermal stratification it was necessary to (1) introduce hot fluid at the top of the liquid storage tank and to add cold fluid at the bottom of the tank, (2) with a cylindrical tank, have a length/diameter ratio equal to or greater than 2.0, (3) use mathematical correlations to determine allowable fluid inlet velocities and temperatures, and (4) use storage tank material that has a thermal conductivity less than that of the storage fluid. The mathematical correlations described in this report allow stratification occurrence to be predicted and can be used to estimate the sharpness of the thermocline based on tank inlet and outlet conditions, fluid properties, and storage tank geometry.

10702 (CONF-800334—(Vol.2), pp 471-489) **Environmental effects of thermal energy storage subsystems.** Ullman, A.Z. (Rockwell International, Canoga Park, CA); Sokolow, B.B. Jun 1980.

From 2. DOE enviroamental control symposium; Reston, VA, USA (17 Mar 1980).

The environmental effects of thermal energy storage (TES) subsystems in solar thermal power systems are examined. Studies performed characterize material releases and other potentially adverse impacts. Particular emphasis is placed on events affecting worker health and safety. Generic TES failure events are considered by an event tree methodology. Categories of initiating events identified include pipe and vessel failure, thermal and mechanical stress, fires, and external events. Relevant materials toxicology is reviewed. Specific near- and medium-term TES designs are reviewed, and three selected for independent analysis: the organic oil/rock sensible heat TES design for Solar 1; an $NaNO_3$/NaOH latent heat TES subsystem; and an SO_2/SO_3 thermochemical energy TES design. Fluid release and flammability hazards in the oil/rock TES design are assessed. The effects of component failures, including ullage and maintenance units, and of operating procedures, are considered in view of design capabilities. The $NaNO_3$NaOH TES design requires the use of complex scraped-wall heat exchangers. Failure of this or other mechanical components presents the principal off-normal route to release of the TES medium. In the SO_2/SO_3 system, release of fluids presents a significant environmental hazard. Events which may lead to release include catalyst deactivation or mechanical equipment failure. The dynamics of failure events are found to be governed both by the solar receiver and recuperator thermal characteristics. Design variations, such as increased recuperator efficiency, are found to have significant and negative effects on the maintenance of system integrity during off-normal events.

10703 **(DOE/R5/10106—2) Longterm solar heat storage in an underground water cistern retrofitted with thermal insulation. Second technical progress report.** Borst, W.L. (Southern Illinois Univ., Carbondale (USA)). 30 Oct 1980. Contract FG02-79R510106. 3p. NTIS, PC A02/MF A01.

The performance of the cistern was tested by measuring storage and surrounding soil temperatures over extended periods of time as heat was added from a solar collector (summer, fall, and winter) or environmental coolness was added (via cold air blown into the cistern) in winter. From these measurements, storage time-constants of the order of 6 months were inferred and verified. (MHR)

10704 **Analysis of solar energy conversion processes: systems economic impact of thermochemical storage efficiencies.** Iannucci, J.J.; Fish, J.D. (Sandia Labs, Livermore, CA). pp 2116-2121 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Chemical storage is the only mode now under consideration for solar thermal electric plants which might satisfy the concept of inexpensive, easily transportable, long duration, ambient temperature storage. The predicted thermal-to-chemical-to-thermal efficiencies for the most prominent of the candidate reactions, however, have been disappointingly low. These low efficiencies are shown to be natural outgrowths from fundamental thermodynamic and engineering principles. Close analogies are drawn between the efficiency of thermal to electric conversion and the efficiency of chemical energy storage processes.

10705 **Markov chains to solar energy storage calculations.** Fernandez, R.O. (R. Fernandez y Asoc., Buenos Aires, Argentina); Garcia, M.V. pp 2227-2231 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The statistic theory of Markov chains has been used to make probabilistic predictions of sequences of variable length of cloudy days starting in a typic day. The calucations were made in Buenos Aires and La Plata, for thirty years of observations of cloudiness based on data of bright sunshine distributed in four intervals. The probabilities of various sequences of different length, and the corresponding storage capacities for different thermal loads have been determined.

15 GEOTHERMAL ENERGY

10706 **GRIPS bibliography.** Napa, CA; GRIPS Commission (1978). 133p. (NP—25232).

This GRIPS (Geothermal Resources Impact Project Study) contains over 1700 references on a wide variety of subjects dealing directly or indirectly with geothermal development at the Geysers/Calistoga KGRA. (MHR)

10707 **Advances in European geothermal research.** Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980). 1096p. (In several languages). (EUR—6862; CONF-8003117—). Kluwer Boston Inc., Hingham, MA.

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

Eighty-eight papers are included. Separate abstracts were prepared for eighty-six. Two papers were entirely in French, Integrated Geothermal Prospecting in the Mont Dore Massif by Varet, et al and Geothermal Operation at Strasbourg-Cronenbourg by The Alsatian Mining Society for Geothermy. Two opening addresses, a keynote speech, and the conference introduction are included. (MHR)

1501 Resource Status And Assessment

REFER ALSO TO CITATION(S) 10729, 10800, 11050, 11092

10708 **(DOE/ET/27085—1) Operations research and systems analysis of geopressured-geothermal energy in Louisiana. Final report for the period June 1, 1978-August 31, 1979.** Johnson, A.E. Jr. (Louisiana Dept. of Natural Resources, Baton Rouge (USA)). Nov 1980. Contract FG08-78ET27085. 295p. NTIS, PC A13/MF A01.

The primary purpose was to provide a projection of the probable future contribution of the geopressured-geothermal energy resource in Louisiana to the overall energy requirements of the nation. A number of associated objectives were emphasized: namely, development of the tools and methodology for performing economic analyses, application of these tools to specific prospects about which adequate resource assessments have been made, identification of the impediments to resource development, and socio-economic analysis of the impact of development of the resource on these specific prospects. An overview of the geopressured-geothermal resource activities in Louisiana is provided first, followed by a detailed discussion and review of the achievements of this project. Finally the major conclusions and findings of this project with respect to commercial viability, impediments, and social and economic impact are presented, and recommendations are made for future systems analysis work.

10709 **(DOE/EV/73002—1(Vol.3), pp 14.1-14.59) Low temperature geothermal space heating.** 1980.

In Alaska Regional Energy Resources Planning Project. Phase 2: coal, hydroelectric and energy alternatives. Volume III. Alaska's alternative energies and regional assessment inventory update.

The potential for low-temperature geothermal energy for home space heating in small communities and remote villages in Alaska is explored. The history of geothermal space heating is traced for the world, the US, and Alaska. The utilization to date and the projected usage of the State's major geothermal springs are listed. The applicability to Alaska, space heating technology, drilling in Alaska, piping, heat exchangers, heat pumps, and environmental impacts are discussed. (MHR)

10710 **(DOE/ID/01756—T1) Regional operations research program for commercialization of geothermal energy in the Rocky Mountain Basin and Range. Final report, August 1, 1978-February 28, 1980.** Marlin, J.M.; Cunniff, R.; McDevitt, P.; Nowotny, K.; O'Dea, P. (New Mexico State Univ., Las Cruces (USA)). Jan 1981. Contract AS07-78ID01756. 126p. (EMD—78-2236). NTIS, PC A07/MF A01.

The work accomplished from August 1978 to February 1980 in the Regional Operations Research efforts for the Rocky Mountain Basin and Range Geothermal Commercialization Program are described. The work included continued data acquisition and extension of the data base, enhancement and refinement of the economic models for electric and direct use applications, site-specific and aggregated analyses in support of the state teams and special analyses in support of several federal agencies.

10711 **Preliminary assessment of the geothermal potential of the United Kingdom.** Burley, A.J.; Smith, I.F.; Lee, M.K.; Burgess, W.G.; Edmunds, W.M.; Arthur, M.J.; Bennett, J.R.P.; Carruthers, R.M.; Downing, R.A.; Houghton, M.T. (Inst. of Geological Sciences, London, England). pp 99-108 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The most likely sources of water at temperatures and flow rates suitable for geothermal development are in Permo-Triassic sandstones in deep sedimentary basins. The distribution and properties of these rocks, together with the quality of the water they contain, have been studied and their potential for geothermal energy development examined. The results are sufficiently encouraging for test drilling at selected sites. The potential for geothermal power from hot crystalline rock has also been assessed from existing geophysical, geological and geochemical data. Heat flow data are limited but several granite batholiths have been identified as preliminary targets, mainly on the basis of their large volume (derived from gravity data) and their above average radiogenic heat production.

10712 **Geothermal potential of late quaternary east Eifel volcanic field.** Schmincke, H.U.; Risse, R.; Woerner, G.; V.D. Bogaard, P.; Viereck, L. (Ruhr-Univ., Bochum, Germany). pp 109-112 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The Laacher See Volcano (Eifel), which erupted 10 500 years B.P., is studied in order to develop methods by which volume and heat content of non-erupted, young, high level, cooling magma bodies can be inferred from analysis of erupted magma fractions. Approximately 1.6 km^3 of phonolitic to tephritic magma was ejected in Plinian and phreatomagmatic eruptions. The erupted products indicate a strongly layered magma chamber with phenocrysts ranging from 5 vol % at the top (san, amph, hau) to about 50 vol % at the bottom (pl, san, cpx, amph, sph, phl, mt, ap, hau, ol). Whole rock compositions range from SiO_2 = 60 and MgO = 0.01 in the first to SiO_2 = 55 and MgO = 5.5 in the last erupted magma. U and Th concentrations show a roofward increase from 2 and 10 up to 35 and 100 ppM. Two compositionally distinct magmatic components with about 1.5 and 5.5 per cent MgO, both containing varying amounts of olivine (Fo_{80}), were erupted from the lower magma levels and suggest incomplete magma mixing between evolved phonolitic and more mafic magma, which was introduced into the chamber. Xenolith investigations and geometrical constraints suggest a cylindrical magma body (diameter 1 km, height 2 km) within Devonian slates and graywackes. Phyllites and mica-schists within the last erupted tephra place the bottom of the magma body at a depth of 4 to 5 km.

10713 **Geothermics in Hainaut (Belgium).** Delmer, A.; Dom, Ph.; Leclercq, D.V.; Hiroux, P.; Legrand, R. (Geological Survey of Belgium, Brussels). pp 113-115 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The geology of the Hainaut region the geothermal research there is reviewed briefly. It is concluded that observations to date suggest a meteoric origin for the waters in the Hainaut province. (MHR)

10714 **Geothermal exploitation in Greece.** Fytikas, M.D. (Inst. for Geology and Mineral Exploration, Athens, Greece). pp 213-237 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

This document gives an account of geothermal exploration in Greece. The first programs of exploration work began in 1970 and led to the discovery of the geothermal field of the island of Milos. A detailed description is given of what has so far been discovered about this field. A number of areas of potential interest from the geothermal point of view can be picked out on the basis of the geological, vulcanological, geochemical and geophysical data available. A brief account is given of unessential features of the most important ones: Thira, Susaki, Metana, Lesvos, the graben of Sperkhos, Strimon and Salonika, Aedipsos, Xanthi, the Thessalian depression and Thrace. The study carried out indicates that Greece is a particularly promising area as regards prospecting for the producing energy from high- and low-enthalpy geothermal fluids.

10715 **Actual situation and future program of geothermal developments in Mexico.** Alonso Espinosa, H. pp 673-679 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

In 1959 a pilot plant generating 600 kW went into operation in Pathe, in the center of the country. Subseqently, in 1973 the first commercial scale geothermal plant, with an installed capacity of 75,000 kW, was finished at Cerro Prieto, B.C. Based on the results of this plant, and in the exploration studies that were performed in such a zone, it was determined to double its capacity, and in April 1979 another 75,000 kW started operation, reaching the present capacity of 150,000 kW. The Federal Power Commission of Mexico continues its inventory on thermal sources of the country, thus in Los Azufres, Michoacan, 10 exploratory wells have been drilled, with very good results obtained. At the same time, detailed studies have been carried out in various zones and states of the republic, in an attempt to achieve a 40,000 kWh production annually by the year 2000.

10716 **Technical and economic feasibility of low enthalpy geothermal projects.** Lejeune, J.M. pp 810-819 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The geothermal potential of the EEC consists essentially of low heat content resources whose optimal development is subject to various types of constraints such as those concerning: techniques for exploration, drilling, exploitations, use, economic and financial reference, criteria, etc... Development of this type of resource supposes detailed analysis of the strategy applied for exploitation, potential uses and economic viability. The study analyses, first of all, the different phases involved from exploration to realization of a project so as to bring out the degree of uncertainty affecting all economic anlayses of a geologically-based project. The inventory of potential uses of low energy geothermal resources shows that very large market can exist especially when it will have become common practice to use hot water resources of all types. Balances can be drawn up and recommendations made for formulating an approach for this type of project on the basis of the experience gained from the 6 existing operations in France and the projects now under way in 7 of the 9 countries of the EEC. Mathematical model building for production cost for geothermal resources was carried out and produced characteristic data for some typical projects.

1502 Geology And Hydrology Of Geothermal Systems

10717 **Vesiculation of mafic magma during replenishment of silicic magma reservoirs.** Eichelberger, J.C. (Sandia National Labs., Albuquerque, NM). Contract W-7405-ENG-36;AC04-76DP00789. *Nature (London) ;* **288**: 446-450(4 Dec 1980).

Mafic inclusions are lower in bulk density than the andesitic and dacitic lavas in which they occur, and apparently represent a foam inflated during rapid cooling of wet mafic magma in contact with cooler, more silicic reservoir magma. This process occurs as mafic magma enters the base of the reservoir, so that the mafic/silicic interface becomes unstable in Rayleigh-Taylor fashion. Mixing in these reservoirs thus depends on water content of mafic magma and pressure.

10718 **Geothermal anomalies in the Rhinegraben sediments and their explanation by uprising deep groundwater from the crystalline basement.** Parini, M. (Institut fuer Geophysik, Zurich, Switzerland); Scriba, H.; Sieber, C.; Werner, D. pp 77-88 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

Geothermal anomalies within the Rhinegraben (Germany) are interpreted postulating the rise of deep groundwater along faults in the basement. The model described is related to the well-known geothermal anomaly of Landau/Pfalz. Relationships are investigated between (a) the temperature in the center of the anomaly, (b) its lateral extension, (c) the water flux, (d) the original depth of the water, and (e) the age of the anomaly. The numerical approach takes into account two processes: thermal conduction and convection in a porous medium. The estimated age of the anomaly is about 100,000 y. The required water flux is very small, and the source depth of the water flow is calculated to be about 6000 m. The presented model of water flow can also be used to interpret the salinity anomaly in the Landau field. An observed zone of fresh water (pore water in the sedimentary cover) coincides with the central part of the thermal anomaly. Using a salinity model corresponding to the hydrothermal model the extension of the fresh water zone can also be simulated.

10719 Integrated geothermal reconnaissance of the Somma-Vesuvius system. Barberi, F. (Univ. of Pisa, Italy); Cioppi, D.; Ghelardoni, R.; Nannini, R.; Sommaruga, C.; Verdiani, G. pp 141-153 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The main results of the first phase of the geothermal exploration of Somma-Vesuvius active volcanic area (including geologic, volcanological, hydrogeological, hydrogeochemical, gravimetric, aeromagnetic, geoelectrical and reflection seismic surveys) are summarized and used for the elaboration of a preliminary geothermal model. The heat source should be provided by the Vesuvius magma chamber that should occur at shallow depth (3 to 5 km) according to petrologic data. The main reservoir is represented by Mesozoic calcareous formations whose top depth ranges in the Vesuvius area, from 500 to more than 1500 m. The impervious cap rock is found in Tertiary flysch or Plio-Quaternary sedimentary sequence overlying the reservoir rocks. The main problem of the geothermal exploration of the area, that is the intensity and lateral extent of the thermal anomaly will be checked by drilling in the next phase planned for 1980.

10720 Geological and geothermal approach of the Pavin area, southern Chaine des Puys (France). Bourdier, J.L.; Vincent, P.M. (Laboratoire de Geologie et Mineralogie, Ferrand, France). pp 238-249 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

In the scope of the evaluation of the geothermal potential of the Chaine des Puys, studies are being effected in its southern part, in the Pavin benmoreitic volcano area. The present results are mainly geological and consist in volcanological and petrological data about the Pavin and the volcanoes with less differentiated lavas associated to it. A conclusion has been drawn that the possibilities of a geothermal anomaly in this area depend on two main factors: the fact that a high level acid intrusion under the Pavin exists or not, and the depth of the differentiation magma chamber. A model of a magma chamber is proposed for the Chaine des Puys. Some parameters of this model, and particularly its depth, have still to be precised. The first geological results of a drilling in order to measure the geothermal flux are presented and discussed.

10721 Investigation of thermal and mineral springs in the Eifel mountains regarding geothermal indications. Langguth, H.R.; Plum, H. (Technical Univ., Aachen, Germany). pp 422-427 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

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As a preliminary study for planned geothermal investigations in the Eifel mountains the hydrogeochemical data published until now were preliminarily interpreted. By applying discriminant analysis four hydrogeochemical groups of springs could be separated. Three of them represent independent types of mineral water whereas the last group represents a type of mixed water. The best separation in discriminant analysis was obtained by the HCO_3-content, the SO_4-content, both in mval %, and the Ca/Mg-ratio. Within the different groups those springs were pointed out which show most clearly the character of the respective group. To obtain a first idea of the geothermal situation in the investigated area SiO_2- and Na-K-Ca-geotemperatures were calculated. Areas with higher geotemperatures were found in the following regions: the region of Aachen, the lower part of the Ahr valley and the area of Daun-Dreis-Gerolstein.

10722 Shallow subsurface temperature field in the Netherlands. Van Dalfsen, W. pp 496-505 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

Shallow subsurface temperatures in The Netherlands were measured in groundwater observation wells. Based on the measurements, temperature maps have been assembled showing temperature intervals of one degree centigrade for depths between 25 and 250 m below ground surface. The relatively low-temperature areas at a depth of 25 m are predominantly groundwater recharge areas. This pattern of relatively low-temperature areas persists to at least a depth of 250 m. The relatively high-temperature areas are situated in the river valleys and in the east and south of the country. The relatively high temperature gradients in the latter areas should be ascribed to the relatively low thermal and hydraulic conductivity of the rock in these parts of the country. The relatively high temperatures in the river valleys are ascribed in first instance to the convective heat transport by upward groundwater flow. Some temperature logs, however, do not show a convexity along the depth-range between ground surface and the less pervious base of the water bearing strata, where groundwater flow is most-likely to occur. This feature as well as the lowest temperatures down to a depth of at least 250 m in groundwater recharge areas stresses the influence of groundwater flow on the subsurface temperature field.

10723 Influence of stratified heterogenities of permeability on the life span of a geothermal doublet. Goblet, P. (Centre d'Informatique Geologique, Fontainebleau, France). pp 720-734 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

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At present, the evaluation of the life span of a geothermal doublet, installed for the purpose of utilizing a geothermal resource, is based entirely on the assumption that the reservoir is homogeneous. This study concerns the value of these evaluations in cases where there are heterogeneities in the aquifer, which have not been discovered during the exploratory phases. The heterogeneities in question are stratified and only concern the permeabilities. The results of the heterogeneous models are compared to those of the equivalent homogeneous one, of same saturated thickness, producing the same yield for the same drawdown. Three types of models are proposed: the homogeneous model itself, alteration of two types of layers, which together have the same thickness as the equivalent homogeneous model, and intercalated layers with relatively high permeability as compared to that of the equivalent medium.

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REFER ALSO TO CITATION(S) 10719, 10721, 10722, 10810, 11277

10724 (LA—8569-MS) Heat-flow measurements in the state of Arkansas. Final report. Roy, R.F.; Taylor, B.; Pyron, A.J.; Maxwell, J.C. (Los Alamos Scientific Lab., NM (USA)). Oct 1980. Contract W-7405-ENG-36. 16p. NTIS, PC A02/MF A01.

Six new heat-flow values are reported for Arkansas, ranging from 1.06×10^{-6} cal/cm^2/s to 3.13×10^{-6} cal/cm^2/s. The pertinent holes are located in the four major geological divisions of the state. The most reliable results are those from Glenwood (1.09 h.f.u.) and Little Rock (1.06 h.f.u.); ground-water problems make the higher remaining values somewhat questionable. Despite the presence of hot springs in the Ouachita region, these figures are not especially encouraging as indicators of a possible geothermal resource, and the low heat-flow in the syenite intrusion at Little Rock is certainly disappointing in terms of hot dry rock exploitation. The most promising area geothermally is in the southern counties (in the Gulf coastal plain), where a compilation of geothermal gradient estimates, made from published well-temperature data, shows a trend towards higher than average gradients.

10725 Geothermal synthesis of the upper Rhine-graben. Munck, F.; Sauer, K.; Walgenwitz, F.; Tietze, R. pp 45-49 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

In the Alsatian and Badean part of the upper Rhine graben, four water bearing formations display characteristics suitable for geothermal energy, which are the Rauracian-Sequanian formations, the Great-Oolite, the upper Muschelkalk and the Bundsandstein. The shape of these aquifers has been obtained with the help of more than 300 basic bore-logs, of data from geophysical investigations, of geological maps and reports, and is represented on maps with their depth, thickness, lithology, temperature and salinity, at scale 1/250.000. The maps of temperature distribution as well as of mineral content of the flowing fluids have been produced from data obtained in oil and thermal water wells. All other available data referring to porosity, permeability and piezometric head are given in tables. The Bundsandstein offers in the northern part of the investigated area, due to its depth and its thickness, the best geothermal reservoir conditions. In the South on the opposite, the Great Oolite and, in part the upper Muschelkalk, are the formations with the main geothermal potential.

10726 Neotectonics and the geothermal anomalies in the Rhinegraben. Illies, J.H.; Hoffers, B. (Universitaet Karlsruhe, Germany). pp 50-61 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

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Positive heat flow anomalies in the Rhinegraben rift system are mainly found in its central segment. This part of the graben is (a) subjected to a compressive shear strain, and (b) a thick intercalcation of a Triassic high-porosity sandstone exists there, between basement and graben fill. The compressive shear strain (a) causes open fractures in the basement with hydrothermal convection. The sandstone body (b) enables a horizontal dilution of the hot water, ascending from the deep fractures, with meteoric water from the recharge area on the graben flanks. In the overlying graben fill, local peaks are observed which superimpose a general geothermal high. Such peaks are mainly controlled by active faults which are superposed on high temperature reservoirs of the deep-seated fissure systems. For geothermal prospecting the mapping of Quaternary active faults on the graben floor is recommended. Numerical calculations of the temperature effect of hydrothermal convection show that the maximum temperature anomaly and the time span of balancing out the temperature depend on (a) the discharge, and (b) the maximum depth of fissures in which convection occurs. The lateral extension of a geothermal anomaly is controlled by the period of water flow. Some numerical results are presented.

10727 Determination of thermal conductivity and diffusivity of Rhinegraben-sediments with a new ring source device. Sattel, G. (Universitaet Karlsruhe, Germany). pp 62-69 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

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A new method was developed to measure the temperature field on the surface of a sediment specimen. This surface was heated by a ring source. The time dependent temperature values in the centre of the heated ring give the volume dependent specific heat, thermal conductivity and thermal diffusivity. It is not difficult to prepare the specimens because it is only necessary to have a smooth but not polished surface. Measurements with variable temperatures and variable hydraulic uniaxial pressures up to 400 bars are possible. The time for one measurement is not longer than one minute. For this reason this device makes large series of thermal measurements possible. More than 800 determinations of thermal parameters of Rhinegraben-sediments have been carried out with these results. The thermal conductivity and the volume dependent specific heat increase with depth. That means, that the thermal conductivity is a function of density, which also increases with depth. These results can explain the negative slope of temperature gradients measured in boreholes near the Landau oilfield and the product of temperature gradient and thermal conductivity gives a constant heat flux of 130 mWm^2.

10728 Numerical calculations of strong temperature gradients at interfaces of horizontally stratified sediments. Schroth, G.J. (Universitaet Karlsruhe, Germany). pp 70-76 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

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Measurements of temperature gradients carried out in oil wells immediately after interruption of production frequently show negative values. Such negative values are in contradiction to a stationary temperature field. The temperature field is calculated with the help of an Explicit Finite Difference scheme for a simulated production process during and after production. The gradients formed at the interfaces of sediment layers, which are identified with that of the thermal diffusivities, are called strong gradients. Their dependence on the duration of the production process and on the contrast of the thermal diffusivities, and also their growth and disappearance after production stops are shown and discussed.

10729 Geothermal evaluation of the Triassic reservoirs of the PARIS Basin. Korotchansky, A.N. pp 116-120 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

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In the PARIS Basin, the area extension of the Triassic outcrops and subcrops is about 12,500 square kilometers. Three potential reservoirs are encountered in the Triassic with temperatures between 25 and 110°C. Development of low enthalpy geothermal energy from the Triassic reservoirs in the PARIS Basin seems to have to rely on the region situated South of ORLEANS in the Val de Loire and in the area situated around COMMERCY in Lorraine, in order to be most likely successful at the right beginning.

10730 Evaluation of preliminary geothermal model for the Phlegraean Fields volcanic area (Italy). Barberi, F. (Univ. of Pisa, Italy); Iannaccone, G.; Innocenti, F.; Luongo, G.; Nunziata, C.; Pascale, G.; Rapolla, A. pp 121-140 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

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The results of volcanological and petrochemical studies, MT surveys, passive seismic studies and a new gravity and magnetic interpretation relatively to the Phlegraean Fields area, Italy, are presented. The evaluation of the geothermal model of the area and a preliminary assessment of the local geothermal resources are presented.

10731 Geothermal survey of the south-east margin of the French Massif-Central. Bosch, B.; Degranges, P.; Demange, J.; Leleu, M.; Marce, A.; Sarcia, C. pp 202-212 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

A geological and geochemical survey of the geothermal possibilities of the south-east margin of the French Massif Central has been done; 24 springs are studied on chemical and isotopical points for water and associated gases. The springs of Lamalou and Lodeve area are ancient waters, with depth temperature close to 100°C; the waters in depth are in one or several non carbonate reservoir. The springs of Val-les-Bains area are waters with depth temperatures up to 150°C; a fissured crystalline reservoir can be deduced from chemical and ^3H data.

10732 Latera exploratory well (northern Latium) Italy. Calamai, A.; Ferrara, G.C. (ENEL, Pisa, Italy). pp 267-283 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The drilling of a geothermal well (Latera 1) in northern Latium was contracted to explore a new area of geothermal interest indicated by ground surveys. The objective of this well was to ascertain whether there are geothermal fluids at depth and, simultaneously, to provide data for verifying the results of the ground surveys. During drilling the well crossed Quarternary effusive volcanic products, Paleocenic-Triassic sedimentary terrains and, finally, intrusive syenitic-type rocks. No significant permeability exists in these terrains due to the intense mineralization that has sealed the fractures originally present in the sedimentary and intrusive rocks. However, it has been shown that the area is indeed of geothermal interest, considering the high temperatures (about 345°C at 2800 m) recorded in the borehole.

10733 **Demonstration project: evaluation of the Mofete high enthalpy reservoir (Phlegrean Fields).** Cioppi, D.; Ghelardoni, R.; Panci, G.; Sommaruga, C.; Verdiani, G. pp 291-302 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

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Mofete 1 and 2 wells' drilling is the first phase of a geothermal evaluation study of Mofete field, the final target of which is the installation of a modular plant for electric energy production of at least 10 MW/sub e/. The whole project includes also drilling of deviated wells and reinjection wells from a few location plants in highly urbanized country. Drilling-crossed volcanic grounds consist mainly of pyroclastic and lavic volcanites and of sedimentary layers. A few mineralized intervals were found at a depth ranging from 500 m to about 2000 m with a fluid temperature between 200°C and 350°C, which are being tested a serie of several analyses. The first gathered data show that drilled wells ascertained a pressured hot water, with high salinity (30 gr/l) and a possible vaporization close to the boreholes. The achieved results show the possibility of developing a program for deeper drilling, down to 3000 m, to recover fluids at higher temperature.

10734 **Hydrogeology and geochemistry of the thermal springs of south-west Tuscany.** D'Amore, F.; Squarci, P. Panichi, C. (CNR, Pisa, Italy). pp 315-329 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

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Various circulation systems have been identified in thermal areas of south-west Tuscany: the main one develops in Mesozoic carbonate and/or evaporitic formations, while other minor circulcations flow through permeable rock masses within the cover formations of the main reservoir. As most of the springs emerge near widespread absorption areas the temperatures computed with the various geothermometers represent minimum values that cannot be extrapolated to deeper zones of the reservoir or zones very far from the emergence point. The geothermometers were also applied to the low salinity springs within the classical geothermal area (Larderello); in this case, despite the fact that the circulation proved to be very shallow in the cover formations, the geothermometers indicated the presence of a marked thermal anomaly.

10735 **Origin and circulation of thermal waters in the Upper Rhinegraben: a chemical and stable isotope study.** Friedrichsen, H. (Universitaet Tuebingen, Germany). pp 330-339 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

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The reservoir temperatures of 22 hot-spring waters from 9 localities in the Upper Rhine Valley and the northern Black Forest have been determined. The ^{18}O (SO_4^{2-}) thermometer and the SiO_2 thermometer yield concordant temperatures in those thermal waters which have not been diluted by near-surface ground water components. Deviations of the SiO_2 thermometer - on the other hand - can be applied for an estimate of near-surface water components in hot spring waters. The alkali content of the waters can not be used for geothermometry. The highest reservoir temperatures have been calculated for the hot springs of Baden-Baden (156°C). All other hot springs have substantially lower reservoir temperatures (115 to 65°C). The ^{18}O and D-values of the thermal water component are comparable with the mean of the ^{18}O and D values of modern meteoric waters from higher elevations of the Black Forest; the cold components have stable isotope ratios of local precipitation.

10736 **Geochemical survey of shallow ground water wells in Denmark.** Jacobsen, O.S. pp 349-359 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The stability of SiO_2 contents in water samples have been tested as a function of time and salinity. There does not seem to be a correlation between salinity and decrease in SiO_2 content with time. The regional ion-exchange of Ca, Na and K have no significant effect on deep ground water. Thus, the SiO_2 may co-precipitate due to oxidation of iron (II). The highest concentration of Br occurs in saline ground waters, although the Cl/Br ratio increases by increasing salinity. The $\delta\ ^{18}O$ investigation on selected saline wells confirms that probably no wells have marine infiltration. The measured temperature range of the investigated wells was between 7.5 and 14.5°C. No indications of migrating hot waters from lower geological strata were found, whereas migration of saline solutions was determined. The use of different types of chemical geothermometers cannot be tested satisfactory due to the very small range in the temperature interval. Thus, the silica-geothermometers appears less reliable within the Danish sedimentary basin, whereas the Na-K-Ca-Mg geothermometers may not be refused as usable, even in calcareous reservoirs.

10737 **Geochemistry of thermal water in the Mont-Dore area.** Bosch, B. (Bureau de Recherches Geologiques et Minieres, Orleans, France); Degranges, P.; Fouillac, C.; Leleu, M.; Sarcia, C. pp 360-368 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

Geochemical study of thermal and mineral springs of the Mont-Dore region gives useful informations on subsuperficial and deep aquifers of the area. By the light of water geochemistry, the area presents all qualitative signs of a geothermal field: an important widely dispersed CO_2 flux characterized by several cold mineral springs; a sulfate rich aqueous system in the Chaudefour valley; and hot and mineralized waters - the Mont Dore springs and the Dordogne valley springs. These four systems obviously not interrelated can be distinguished by their chemical and isotopic properties. The thermal area of Dordogne valley springs constitute the most interesting zone for geothermal purposes. Confident temperature determination can be made (~ 150°) for these waters. Occurrence of a deep water level at higher temperature (180°) is also possible.

10738 **Geothermal applications of the geochemical study of hot springs in eastern Pyrenees.** Michard, G.; Fouillac, C.; Ouzounian, G.; Boulegue, J.; Denuynck, M. (Univ. of Paris, France). pp 387-395 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

A geochemical study of about 150 hot springs in Pyrenees and Corsica allows us: to achieve a global modelling of the chemistry of the springs, as a function of two master variables: deep temperature and charge of soluble anions; to get an insight on the behavior of some trace elements in thermal waters and to derive an empirical new geothermometer, the Na/Li ratio; and to make a new discussion of previous results in Massif Central; the geothermal interest of Limagne and St Flour areas is confirmed.

10739 Trace element geochemistry in thermal waters from Plombieres and Bains (Vosges). Gijbels, R.; Van Grieken, R.; Blommaert, W.; Vandelannoote, R.; Van't Dack, L. (Univ. of Antwerp, Wilrijk, Belgium). pp 396-409 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

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The thermal waters of Plombieres and Bains can be described as mixtures of Sondage Neuf water (Plombieres) and cold water. The soluble elements (e.g. Li, Na, Rb, Cs, W, As, F) are useful for calculating mixing ratios between the hottest water of the region (Sondage Neuf) and cold water, both at Plombieres and Bains. A new quartz-scheelite geothermometer is described which allows to calculate the fraction of hot water in a given source, and at the same time its temperature in depth (before mixing). Some limitations of this approach are discussed. For a number of elements in Sondage Neuf water the concentration is controlled by the solubility of their (hydro)-oxides (Sc, Ga, Zr, Th) or fluoride (La) at the temperature of emergence. The Mn, Fe, Co, Ni, Zn, Ge, As, Cd, In, Hg and Pb content appears to be controlled by the solubility of their sulfides at a temperature of about 100°C. At that temperature the dissolved sulfide is oxidized to sulfate, so that the concentration of these trace elements does not decrease further during cooling. The suspended matter originates from the precipitation of the above elements, accompanied by coprecipitation or adsorption of other elements.

10740 Geochemical sampling and analysis of geothermal fluids in sedimentary basins. Edmunds, W.M. (Inst. of Geological Sciences, Wallingford, England); Burgess, W.G.; Bath, A.H.; Miles, D.L.; Andrews, J.N. pp 410-421 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

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Techniques are described for the recovery of formation waters from deep sedimentary aquifers which enable the maximum information to be obtained from individual boreholes drilled for geothermal exploration. The scale of contamination involved in two recovery methods is illustrated and it is suggested that most reliable samples are obtained by centrifugation of interstitial water from core material. Methods used in the analysis of small volumes are listed and the need for modification of methods usually used for dilute solutions is stressed, and their limitations illustrated. A method designed to determine the ^4He content of interstitial water from recovered cores, the problems of oxygen and hydrogen stable isotope analysis of brines, are discussed. Results from exploration boreholes in the U.K. are used as illustrations.

10741 Some remarks on the application of geochemical techniques in geothermal exploration. Tonani, F.B. pp 428-443 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

An overview is given of the original contribution of geochemistry to geothermal exploration. A few subjects are highlighted: geochemical thermometry, detection of geothermal steam leaking from reservoirs, and geochemical logging of drilling mud. One specific approach to use of geochemistry in geothermal exploration is described. Explicitly bayesian presentation of the problems was found expedient to producing a condensed view of how and why the procedure works. (MHR)

10742 Heat flow pattern of the United Kingdom. Oxburgh, E.R.; Richardson, S.W.; Wright, S.M.; Jones, M.Q.W.; Penney, S.R.; Watson, S.A.; Bloomer, J.R. (Dept. of Geology and Mineralogy, Oxford, England). pp 447-455 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

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The mean UK heat flow is a very normal 59 mWm^{-2}, yet the values vary systematically over the country between 40 and 100 mWm^{-2}. There is no geological or geophysical indication that this variation is caused by recent thermal events in the mantle. A firm correlation between heat flow and basement heat production strongly suggests that the variation originates in the upper half of the crust. Belts of higher heat flow are underlain by granite-enriched upper crust. The granite bodies are of approximately the same vertical thickness as the low-grade metamorphic rocks which they intrude: both are underlain by dense lower crust relatively depleted in heat production. These relationships imply that near surface heat flow anomalies should persist to many kilometers depth. Thus high surface temperature gradients in granites should continue down to all drillable depths. Geothermal resources exist in such bodies, particularly where they are insulated by overlying low conductivity sediments.

10743 Exploration and interpretation of the SW England geothermal anomaly. Wheildon, J.; Francis, M.F.; Ellis, J.R.L.; Thomas-Betts, A. (Imperial College of Science and Technology, London, England). pp 456-465 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The high magnitudes of the first reported heat flows in SW England led to serious speculation that deep convective circulation was a possible contributing factor to the measured surface heat flow. Were convective circulation to exist, the consequential heat flow enhancement would be localized. The strategy of this research was therefore to extend the coverage of heat flow over the entire Cornubian batholith, and its environs. This has been achieved through two phases of contract support from the Commission and the UK Department of Energy. In the first phase eleven new heat flow sites were occupied, and in the second phase twenty-five new sites have been completed, bringing the total coverage for SW England, including six earlier published values, up to a total of forty-two. The uniformly high values associated with the granite (around 120 mWm^{-2}) contrast with normal heat flow (around 60 mWm^{-2}) at sites remote from the granite. The uniformity of the granite values suggests that convective transfer is not a significant mechanism. Furthermore using model studies it is shown that the observed significant contrasts in thermal conductivity and heat production, combined with the likely space-form of the granite, reasonably account for the observed heat flow distribution. This study therefore reaffirms the Cornubian batholith as the most favourable UK site for HDR development.

10744 Terrestrial heat flow in France. Gable, R. (Bureau de Recherches Geologiques et Minieres, Orleans, France). pp 466-473 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The results of heat flow determinations in France have shown regions of high values generally connected with recent geological features (graben) and in relation with elevation of Mohorovicic discontinuity. The high heat flow values of a specific area such as the Massif Armoricain could be explained by the radiogenic heat production. In general the level of heat flow in France is high compared with that of surrounding countries.

10745 Critical study of heat flow data in France. Vasseur, G. (Centre Geologique et Geophysique, Montpellier, France). pp 474-484 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

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More than 160 heat flow data with different origins have been combined in order to outline the major trends of heat flow in France. The basic data are separated into different groups according to the various characteristics of the measurement and a systematic comparison between each group is attempted. In particular, classical measurements obtained from conductivity determination

and temperature logging in shallow boreholes are compared with measurements derived from bottom hole temperature in deep oil exploration wells. As a result of this investigation, a 30 % difference between the two types of data is suggested. This bias could result from paleoclimatic temperature variations. Its potential effect upon the heat flow pattern of France is briefly discussed.

10746 **Geothermal trends of Denmark.** Balling, N.; Kristiansen, J.I.; Poulsen, K.D.; Saxov, S. (Aarhus Univ., Denmark). pp 485-495 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

In the first phase of the EC program all temperature measurements reported from Danish land borings drilled to depths greater than 500 m were compiled. From 50 holes 194 measurements were available, almost exclusively bottom hole temperatures (BHT) from oil and gas exploration boreholes. Most data originate from North Jylland. Due to the great inhomogeneity of data, only generalized geoisotherms were mapped. The temperature trends show the highest values in areas with the thickest sequences of sedimentary rocks. From the BHT, heat flow was estimated at six sites. Values range from 43 to 66 mWm^{-2}. Climatic corrections may increase these values by at least 10 mWm^{-2}. In the second phase, the work has been aimed at measuring accurate temperatures and heat flow. Four heat flow boreholes are drilled to depths of 150 m to 250 m, and measurements are carried out in shallow boreholes and a more than 3 km deep borehole drilled by other agencies. New temperature logging equipment has been built, needle probe and divided bar thermal conductivity equipment and data interpretation techniques have been improved. Heat production and in particular a great number of thermal conductivities have been measured on core materials. New heat flow values are determined as the holes reach thermal equilibrium. It is concluded that so far only in central North Jylland subsurface temperatures are known with reasonable accuracy.

10747 **Temperature and heat flow patterns of Italy.** Fanelli, M.; Rossi, A.; Salomone, M.; Taffi, L. (CNR, Pisa, Italy). pp 506-515 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

A preliminary reconstruction of the underground temperature regime in Italy has been made, using terrestrial heat flow values measured during pure and applied research, temperature data from oil and geothermal wells and the values measured in oil and geothermal reservoirs. Due to the fact that the data were not always reliable or distributed uniformly, the resulting maps (terrestrial heat flow and temperature at different depths) are of a semiquantitative nature. Although representing the regional trend there may be a certain margin of uncertainty on a detailed scale.

10748 **Harmonic pick-up: preliminary mathematical model for interpretation.** Fras, G.; Thillier, J.M.; Jouanna, P. (Universite des Sciences et Techniques du Languedoc, Montpellier, France). pp 516-520 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

A simple preliminary model was devised simulating the geometry of a heat exchanger in order to interpret the measurements obtained with the pick-up. The exchanger is assumed to be a cylindrical fracture with radius Rf and thickness e, crossed in the centre by a boring with radius Rp, perpendicular to plane of the fracture. The transfer function between the flow at entry of fracture and the pressure measured at the same point depends biunivocally on the parameters e, Rp, and Rf, and characterizes the fracture. A set of transfer functions was drawn up, referred to as the spectral signatures. Identification of the parameters in situ is carried out by comparison of the experimental signature with this set of functions.

10749 **Perfecting of a harmonic pick-up for the simultaneous detection of the thickness and extent of a fracture crossed by a boring.** Crosnier, B.; Portales, J.L.; Jouanna, P. (Universite des Sciences et Techniques du Languedoc, Montpellier, France). pp 521-524 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The survey of fractured media by non-steady water tests requires the creation of dynamic signals at the entry to the fractures. Apparatus designed for such field survey is described. This apparatus can create a sinusoidal pulse flow inside the fracture and measure the pressure. Between two packers, set above and below the fracture, an alternating piston applies pressure through a membrane to fluid in the fracture. A sensitive oil pressure detector measures pressure and temperature. Signals are transmitted to the head of the boring by a frequency modulation device. This pick-up is designed for borings as deep as 2000 m, 165 mm in diameter, and with temperatures up to 150°C.

10750 **Design and testing of down hole probes for operation in deep and hot environments.** Ceppatelli, L.; Ferrara, G.C. (ENEL, Pisa, Italy). pp 535-544 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

All the parts of the electrical device for measuring temperature and pressure in geothermal boreholes were constructed. Further research directed at improving geothermal measuring techniques were constructed. Further research directed at improving geothermal measuring techniques led to the development of two probes, one for measuring the diameter of geothermal boreholes (CALIPER) and the other for determining fluid characteristics at wellhead (ISOKINETIC PROBE). With the first probe one can measure the diameter of the wells along two orthogonal axes and define fluid velocity in a longitudinal direction during production or injection tests. The isokinetic probe represents a new instrument for studying fluid characteristics at wellhead. By taking an isokinetic sample of fluid along the well radius one can trace profiles of the flow in the various phases. CISE of Milan carried out the design and construction of both probes.

10751 **Direct heat flow measurement probe project.** Bertaux, M.G.; Bienfait, G.; Jolivet, J.; Vasseur, G. (Institut de Physique du Globe, Paris, France). pp 545-555 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

A method for direct measurement of terrestrial heat flow has been developed and a new probe constructed, whose originality consists in its ability of producing, by Peltier effect, an additional heat flow acting like a local perturbation upon the preexisting thermal field. An elementary theory made upon a simplified model shows that when special experimental conditions are fulfilled, Peltier strength put on the probe is proportional to the preexisting heat flow. In order to obtain numerical results for the more complex real configuration of the system, modeling has been realized, using finite element computer methods. General results are given, together with a model for the probe and detailed method of experimentation.

10752 **In-situ thermal conductivity probe.** Musmann, G.; Kessels, W. (Institut fuer Geophysik und Meteorologie, Braunschweig, Germany). pp 556-564 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

It was the aim of this investigation to develop and test a probe for in-situ thermal conductivity measurements also applicable for rocks. First a new theory for a spherical probe for absolute measurements was developed. A sensor including the spherical probe (heater) and a downhole hydraulic drilling mechanism for

drilling well defined special side boreholes was constructed and tested in limestone clay and slate. A first application of the sensor was done in flat drillings around Lake Laach (Eifel) in addition to temperature gradient measurements. The data evaluation of the temperature and thermal conductivity measurements are presented. High gradients compared to the Eifel area could be detected from 2 out of 5 flat drillings close to Lake Laach.

10753 Seismological investigations in Urach. Schneider, G. (Univ. of Stuttgart, Germany). pp 567-575 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

Earthquake signals are used to study the underground structure of the Urach geothermal anomaly. Influences on travel-times as well as on amplitudes of body waves could be observed. Analysis of travel time curves indicates a general upwarping of the CONRAD-discontinuity under the anomaly. At some places material with a P-wave velocity of 6.5 km/s reaches depths of about 5 km. A comparison between shape and spectrum of phases from local earthquarkes indicates higher absorptivity in the center of the anomaly. This difference can be interpreted as a temperature increase of 50...100 K in the upper crust. A guiding effect increases the spectral amplitudes around 1 Hz of north-south travelling waves.

10754 Combined reflection and refraction measurements for investigating the geothermal anomaly of Urach. Meissner, R. (Kiel Univ., Germany); Bartelsen, H.; Krey, T.; Schmoll, J. pp 587-602 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The combined seismic reflection and refraction measurements in the Urach area have revealed many details of the geothermal anomaly. Horizontal velocities show a minimum at the center of the anomaly in the uppermost part of the crystalline basement. (Vertical) stacking velocity show this velocity minimum to extend down to the bottom of the crust showing up to 5% velocity variations at deep crustal levels as compared to the average value along the profile I. This effect is stronger than predicted from theoretical calculations of the thermal effect of a temperature difference of 50 or 100°C. The center of the Urach anomaly coincides with a relative maximum of crustal thickness and with a change of dip of deep crustal reflectors. Some indications of faults, possibly important for magma breakthrough, could be mapped along the profiles.

10755 Seismic studies for the determination of the crustal structure in the area of the geothermal anomaly in Tuscany. Giese, P.; (Freie Univ., Berlin, Germany); Wigger, P.; Morelli, C.; Nicolich, R. pp 603-613 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

Refraction seismic measurements were carried out in July 1978 and 1979 in Tuscany and Latium with the goal of perceiving the crustal and upper mantle structure and the velocity distribution in the geothermal anomaly of Tuscany. The main results are: the crust of Tuscany is thin. Because of the relative high velocity and the lack of distinct velocity inversions it must be excluded that a greater extent of molten material in the upper crust could be found. However, the transition zone to the upper mantle shows layers of extreme low velocity, temperatures of at least 600 to 700°C have to be expected in this region. Besides, in the transition zone under the area of Lardarello a jump of 6 to 7 km to the upper mantle was found possibly corresponding to the jump in the basement of that region. Model calculations which were made for the temperature distribution in this area are discussed.

10756 V/sub P//V/sub S/ ratio and its changes in the Travale geothermal field. Casertano, L.; Oliveri Del Castillo, A. pp 614-621 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

A seismic network, based on newly designed and assembled equipment, has been set up in the Travale geothermal field, South-West of the Era graben, and explosions have been produced on the opposite edge of the graben (in the Montagnola Senese region) by 5 successive seismic energy steps. Obscured arrivals in almost all recording stations are infer absence of structural connections between the edges that are likely rigid at shallow depths. If so, new arguments have to be taken into account for substantiating several interpretations that seemed quite established.

10757 Identification of 3 D bodies by Moho reflected waves application to the Mont Dore area. Nercessian, A.; Hirn, A. (Institut de Physique du Globe, Paris, France). pp 622-631 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

About 480 records of critical incidence P/sub M/P waves (reflected sideways on the Moho and transmitted through the upper crust) have been obtained on a 15 x 20km array on the Mont Dore from four main shotpoints in different azimuths. After compensating the arrival times for the elevation and distance, the range of residuals still remains larger than 0.2s, variations occuring on a small geographical scale and without a simple coincidence from one shotpoint to the other. Attempts at modeling the uppercrustal heterogeneity follow by inversion of data into relative values of velocity in blocks of 2km dimensions. This inversion indicates that a volume with low-velocity in the quadrangle La Bourboule-Roc de Courlande-Sancy - Lac de Guery persists to a depth of -1.5km with well-defined lateral limits. At these depths generally higher velocities indicate probably the undisturbed basement which is thus found much deeper than the + 0.5km previously estimated from other techniques. Low velocities persist down to several kilometers near La Banne d'Ordanche and S-W of Puy de Sancy, whereas low velocities may occur beneath higher ones near parts of the rims of the mentioned quadrangle. The raw amplitudes of P/sub M/P waves have also been tentatively inverted. Further evaluation including that of spectral content should contribute to refine the image which at this time seems to associate attenuation and low velocity, some examples of inverse relationship being encountered.

10758 Seismic investigations of the Mont Dore caldera. Ferrandes, R.; Gerard, A.; Muraour, P.; Peragallo, J.; Petiau, G. pp 632-647 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980). (In French)

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The results given below are mainly presented in the form of an explanatory section of the media filling up the Mont Dore caldera. This model was drawn from a 7 km long profile studied by seismic refraction, completed by 7 seismic reflection recordings which did not show an obvious reflecting surface intercalated between the layers discovered by refraction. An experimental study of the seismic noise shows very high intensities in the frequencies, close to 1 Hz with local maxima detected by magnetotelluric method.

10759 Investigation of the microseismic noise of the geothermal anomaly at Torre Alfina (Italy). Steinwachs, M. (Geological Survey of Lower Saxony, Hannover, Germany). pp 648-653 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

Between September 10-October 5, 1979 the seismic noise was measured at 15 points in the geothermal anomaly Torre Alfina using 6 mobile seismological telemetric stations. In the centre of the

anomaly an increase of the spectral density of the noise was even more clearly observed than in the case of earlier measurements made at the anomaly at Urach. This increase is particularly marked in the frequencies between 30 to 40 Hz.

10760 **How can seismics, especially active, assist in geothermal energy utilization.** Krey, Th. pp 654-671 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

In high enthalpy geothermal techniques, seismics provides the possibility to recognize regions with decreased velocities, especially when CDP-techniques are applied in active seismics. These regions may point to bodies of increased temperature. The evaluation of attenuation of shear waves may assist in finding such bodies. In low enthalpy geothermal techniques, the structure of porous and permeable layers can be outlined by the same seismic methods as applied to oil and gas exploration, and special methods, including 3-D-seismics, may help to disentangle complicated fault systems. In present or recent volcanic areas bright spots may solve the question of whether pores are filled by hot water or water vapor.

10761 **Application of dc dipolar methods in the upper Rhinegraben.** Baudu, R.; Bernard, J.; Georgel, J.M.; Griveau, P.; Rugo, R. pp 823-832 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The aim of this project was to improve both the technology and the methodology of the electrical dc soundings when used to prospect geothermal reservoirs. A theoretical study of dipole dipole soundings assuming a general array gave the conditions for stable array response under tabular conditions and showed that the equatorial configuration was optimal under several criteria. A semi automatic interpretation method in the tabular case was developed for dipolar sounding curves obtained with stable response arrays. In order to measure the low level signals due to high conductivity terranes equipment was adapted to permit stacking process with selection. The equipment was tested on a well known geothermal anomaly of the Rhine Graben. A polar dipole dipole profile showed a rather superficial conductive anomaly in relation with the temperature anomaly. Dipolar soundings pointed out the necessity of using a bipole current line because of the weakness of the signals. A rowing dipole mapping showed that the terranes in relation with the temperature anomaly had a lower resistivity but it did not reach the outer limit of this anomaly.

10762 **Dipole-dipole study of the Travale geothermal field.** Patella, D.; Quarto, R.; Tramacere, A. (Univ. of Bari, Italy). pp 833-842 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The application of the dipole sounding method in the Travale geothermal area (Tuscany) is studied as a part of a wider research addressed to a systematic study of the exploring power of the method. It constitutes a first attempt for the realization of an efficacious prospecting technique in areas of geothermal interest. For this reason the choice of the known geothermal area of Travale appears largely justified owing to the information at present available about geological, hydrogeological, geophysical and geothermal aspects. First a brief outline of the adopted field technique and of the method used for data acquisition are given. Then, after showing the obtained field dipole apparent resistivity diagrams, the method of transformation into Schlumberger equivalent curves is discussed together with its implications as far as quantitative interpretation is concerned. Two preliminary geological sections are finally presented as a result of a combined geoelectrical, geological and geothermal interpretation.

10763 **Distribution of electrical conductivity in crust and upper mantle in the area of the geothermal anomaly of Tuscany/Italy.** Haak, V.; Schwarz, G. (Freie Univ., Berlen, Germany). pp 843-853 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

Magnetotelluric measurements have been carried out in the geothermal area of Tuscany in order to determine the distribution of the electrical resistivity within the crust. The geological structure and the distribution of temperature will be inferred therefrom. The results presented here indicate clearly a rather high total conductance of the surface layers up to 1000 S which can vary considerably at some places. A geological interpretation points to a very high conducting layer in depths down to 10 km overlain by a higher resistive material. This deep, highly conducting layer and the transition to the underlain high resistive basement may correlate with the deep reflection horizons detected by reflection and refraction seismics.

10764 **Three-dimensional resistivity modelling by the integral equation method.** Barthes, V.; Vasseur, G. (Universite des Sciences et Techniques du Languedoc, Montpellier, France). pp 854-874 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

A numerical model has been constructed to determine the electric field, electric potential, and apparent resistivity above a three-dimensional conductive inhomogeneity buried in a horizontally stratified earth with point sources of current arbitrarily situated at ground level or at depth. The problem is formulated as an integral equation; the electric potential is written as a surface integral in which the domain of integration is only the bounding surface of the inhomogeneity. The integral equation is transformed into a linear system which can be solved numerically. The numerical modelling procedure is described and two examples of applications are given. Several models have been formulated and compared to analog results obtained with an electrolytic tank.

10765 **Magnetic survey in the Travale geothermal field, Italy.** Napoleone, G.; Poggiali, G.; Ripepe, M.; Savino, D. (Univ. of Florence, Italy). pp 875-883 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The detailed magnetic survey has covered the area between the villages of Boccheggiano, Travale and Radicondoli, where supposedly is confined the most active geothermal field. Along with the main structural setting of the region, the magnetic anomalies (ranging in the order of 100 gammas) seem to depict the major trend of the westerly edge of the Era-graben and the associated fault system across it, where the present geothermal activity has taken place. Changes in the rock magnetic properties for the crustal layer affected by thermal processes suggest an explanation for the local anomaly closely related to the geothermal area.

10766 **Use of the differential magnetic sounding for studying the geothermal potential resources of the Rhinegraben.** Mosnier, J.; Babour, K. pp 884-892 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The differential magnetic sounding had allowed us to point out an important conductivity anomaly in the Rhinegraben in 1977. In 1978 to 1979, it was shown that the telluric currents responsible for this anomaly were confined in the sedimentary filling of the graben to the exclusion of the resistive basement. A detailed study of the area of Pechelbronn has shown that local anomalies could be superposed upon the regional one but that their study was not easy, specially with regard to their interpretation in geothermal terms.

10767 **Magnetovariational and magnetotelluric soundings in Rheingraben and Schwarzwald.** Richards, M.L.; Schmucker, U.; Steveling, E.; Watermann, J. pp 893-903 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

With a combination of instruments to measure electromagnetic field variations in the period range from 6s to 24h, and appropriate station coverage of the region comprising Rheingraben, Schwarzwald and Swabian Alb, it should be possible to obtain data for improved conductivity models of the Rheingraben and Urach geothermal anomalies. The surveys in 1977/78 were designed with this objective, and some results were obtained for selected effects to present. The perturbation of magnetic field near the Rheingraben indicates the presence of anomalous currents. The effect is frequency dependent, the higher frequency results reflecting the graben sedimentary structure and the lower frequencies a possibly deeper seated anomaly. Magnetotelluric soundings using pulsations also show this contrast in shallow structure between the graben and Schwarzwald. At longer periods a deeper structure in the graben is indicated. Near the Urach volcanic area there is also a strong magnetic field perturbation.

10768 **Magnetotelluric survey of the Lake Laach (Eifel) volcanic area.** Musmann, G.; Gramkow, B.; Lohr, U.; Kertz, W. (Technische Univ., Braunschweig, Germany). pp 904-910 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

In 1978 and 1979 a total of 9 geoelectric Schlumberger soundings and 14 magnetotelluric soundings were carried out along a 10 km profile across Lake Laach in the Eifel volcanic area. It is the aim to detect the proposed existence of a magma chamber in a depth of a few km which may cause a conductivity low. The evaluation of the geoelectric sounding curves is completed and shows a clear differentiated stratified subsoil in lateral direction down to a depth of about 300 m. The upper resistivities are about 300 Ωm around Lake Laach and only 50 Ωm below the lake. These values will be fed into the later model calculations for MT evaluation. The interpretation of the rho/sub a/-curves from the MT-recordings is fairly complicated due to the high noise level all over the area and due to short distance lateral inhomogeneities. Strong differences were observed between the two corresponding orthogonal rho/sub a/-curves. The final interpretation of the shown pseudo-cross-section needs three dimensional model calculations which is under investigation.

10769 **Magnetotelluric measurements and geomagnetic depth sounding in the area of the Urach geothermal anomaly.** Berktold, A.; Kemmerle, K.; Neurieder, P. (Muenchen Univ., Germany). pp 911-920 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The variations of the natural electric and magnetic field have been measured mainly along 2 profiles within the geothermal anomaly, one profile parallel and one perpendicular to the strike of the Swabian Alb. The electromagnetic variations have been registrated in the period range of 6 to 100 sec. No clear correlation could be found between the lateral variation of conductivity and temperature along the 2 profiles. There is, however, a strong lateral variation of the electrical conductivity within the area of volcanic eruptions. An anomaly of increased electrical conductivity has been found in the central part of the volcanic area the width being about 15 km. The anomaly is elongated in NS or NNW-SSE direction. The continuation in these directions is not fully known. The conductivity seems to be increased within this anomaly to several km depth. This may be caused by fractures in the sedimentary cover and in the cristalline basement which are filled with highly conducting fluids. A two-dimensional conductivity anomaly exists in greater depth below the Swabian Alb striking parallel to the Alb.

10770 **Magnetotelluric prospection of the Mont Dore area.** Dupis, A.; Marie, Ph.; Petiau, G. pp 935-943 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The existence of a caldera in the Mont Dore region can hardly be questioned. However to estimate an eventual geothermal interest of the structure, it was essential to undertake a detailed study of its outline, of its filling and of its deep formations. In this work the results of magnetotelluric observations with three different devices allowing measurements from some tens of meters to some kilometers are given. In spite of relief and industrial disturbances of the natural electromagnetic field a coherent set of results is proposed. These are in harmony with the results of other geophysical methods and with geological observations or inferences. They consist essentially of two maps giving the isobaths of the top of conducting formations, of geoelectric sections throwing the most interesting zones into relief, and of the selection of a polygonal area where a productive geothermal reservoir may be.

1506 Environmental Aspects And Waste Disposal

REFER ALSO TO CITATION(S) 10391, 10777, 11549, 11561

10771 (CONF-800334—(Vol.2), pp 686-698) **Highlights of the test results from the operation of a 5 MW pilot plant demonstration of the EIC process at the Geysers.** Allen, G.W. (Pacific Gas and Electric Co., San Ramon, CA); Brown, F.C. Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The results of the six months test campaign demonstrated the copper sulfate process concept: the scrubbing step is stable, can cope with steams of widely varying composition and condition, and is capable of achieving routinely high degrees of abatement. The liquid-solid separation step is reliable and regeneration and recycle of the copper sulfide solids is easy and quantitative. The process is not consumptive of large amounts of chemicals and produces waste products which can be disposed of by reinjection with cooling tower blowdown or by evaporation and off-site disposal. Preliminary cost estimates have shown that the direct operating costs for the process will be lower than for existing alternatives at comparable degrees of abatement. Since the process can cope with the troublesome problem of preplant emissions as a normal feature of operation, additional cost advantages will be realized vis-a-vis the use of downstream abatement techniques. (MHR)

10772 (DOE/ET/28482—T1) **GRIPS Plan.** (GRIPS Joint Powers Agency, Napa, CA (USA)). 31 Jul 1978. Contract FG03-77ET28482. 170p. NTIS, PC A08/MF A01.

The GRIPS (Geothermal Resources Impact Projection Study) Commission was established by a Joint Powers Agreement between the California Counties of Lake, Mendocino, Napa, and Sonoma. The objectives of GRIPS are primarily to develop and use a cooperative environmental data collection and use system including natural, social, and economic considerations to facilitate their independent decisions and those of State and Federal agencies related to the environmental effects of geothermal development. This GRIPS Plan was prepared from a wide range of studies, workshops, and staff analyses. The plan is presented in four parts: summary and introduction; environmental data status report; planned programs; and budget. (MHR)

10773 (UCRL—15317) **Environmental overview for the development of geothermal resources in the State of New Mexico. Final report.** Bryant, M.; Starkey, A.H.; Dick-Peddie, W.A. (New Mexico State Univ., Las Cruces (USA); New Mexico State Univ., Las Cruces (USA). New Mexico Energy Inst.). Jun 1980. Contract W-7405-ENG-48. 268p. (NMEI—53). NTIS, PC A12/MF A01.

A brief overview of the present day geothermal applications for hydrothermal electrical generation and direct heat use and their environmental implications is provided. Technologies and environ-

mental impacts are considered at all points on the pathway of development resource exploration; well field, plant and transmission line construction; and plant operation. The technologies for electrical generation-direct, dry steam conversion; separated steam conversion; single-flash conversion, separated-steam/single-flash conversion and binary cycle conversion and the technologies for direct heat use - direct use of geothermal waters, surface heat exhanger, down-the hole heat exchanger and heat pump are described. A summary of the geothermal technologies planned or in operation within New Mexico geothermal areas is provided. A review of regulations that affect geothermal development and its related environmental impact in New Mexico is presented. The regulatory pathway, both state and federal, of geothermal exploration after the securing of appropriate leases, development, and construction and implementation of a geothermal facility are described. Six categories (Geophysical, Water, Air, Noise, Biota and Socioeconomics) were selected for environmental assessment. The data available is described.

1508 Geothermal Power Plants

10774 **(DOE/ET/27193—T1) Improved liquid/solids handling module. Final report 2321:01, 1 September 1979-31 October 1980.** West, L.K. (Aerojet Energy Conversion Co., Sacramento, CA (USA)). 1980. Contract AC03-79ET27193. 65p. NTIS, PC A04/MF A01.

A Mobile Liquid/Solids handling (L/S) unit was constructed that is the active element for a low cost Advanced Primary Geothermal Heat Exchanger (APEX), presently under development. The L/S system incorporates two alternating hydrocyclone-accumulator tank combinations and an injection pump. Sand particles are injected into the main flow and then separated and recirculated at capture efficiencies of greater than 99%. The system was tested at varying flowrates, solids concentrations, and particle sizes to determine an optimum operating point.

10775 **Thermogravimetric loop for converting low enthalpy geothermal energy into electricity.** Trebbi, G. pp 694-705 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

ENEL is completing, under contract with the Commission of the European Communities, the construction in Larderello of a pilot plant suitable for the exploitation of low temperatures geothermal sources. The main design characteristics are described. The expansion of freon 114 operating in the cycle takes place in the rising leg of a gravimetric circuit where a low density mixture of vapour freon and water is flowing. The hight of the water column between freon injection point and the free level in the separator is 45 m. After the separation, the water flows down and feeds an hydraulic turbine of about 25 kW. The results of technical and economical feasibility study considering units of 100, 1000, 5000 kW are reported. The possibility of increasing the cycle performance and lowering the costs are pinpointed; finally is outlined the project of installing a freon turbine instead of a gravimetric loop.

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REFER ALSO TO CITATION(S) 10252, 10805

10776 **(DOE/ET/27026—T6) Geothermal analytical report.** (Radian Corp., Austin, TX (USA)). 1980. Contract AC02-79ET27026. 9p. NTIS, PC A02/MF A01.

Two samples were precracked by fatigue and exposed to separated geothermal brines in a closed autoclave. Final load and crack length were measured and a fractographic examination performed on compact double cantilever beam samples. The fractographs are shown. (MHR)

10777 **(DOE/ET/27146—T1) Particle characterization for geothermal operations.** Vetter, O.J.; Kandarpa, V. (Vetter Research, Costa Mesa, CA (USA)). 6 Jan 1981. Contract AC03-78ET27146. 50p. NTIS, PC A03/MF A01.

A detailed summary of an ongoing evaluation of existing particle measuring methodology with emphasis on (a) adapting of existing methods in geothermal operations and (b) further development of existing instrumentation for field use is presented. The various instruments and methods used and/or suggested for particle characterization are described in detail. Theoretical and practical aspects of particle characterizations are outlined. A plan for further laboratory and field experiments is outlined. The instrumentations to be selected after some additional lab and field tests will be used in the studies on (a) formation damage through particle invasion and (b) characterizing and monitoring of particle suspensions in geothermal operations.

10778 **(DOE/ET/27225—12) Next steps in two-phase flow: executive summary.** DiPippo, R. (Brown Univ., Providence, RI (USA)). Sep 1980. Contract AC02-79ET27225. 59p. (CONF-800786—(Exec.Summ.)). NTIS, PC A04/MF A01.

From Symposium on the next steps in two-phase flow; Providence, RI, USA (21 Jul 1980).

The executive summary includes the following topics of discussion: the state of affairs; the fundamental governing equations; the one-dimensional mixture model; the drift-flux model; the Denver Research Institute two-phase geothermal flow program; two-phase flow pattern transition criteria; a two-fluid model under development; the mixture model as applied to geothermal well flow; DRI downwell instrumentation; two-phase flow instrumentation; the Sperry Research Corporation downhole pump and gravity-head heat exchanger systems; and the Brown University two-phase flow experimental program. (MHR)

10779 **(LA-UR—81-26) Review of the geothermal reservoir well stimulation program.** Campbell, D.A.; Hanold, R.J.; Sinclair, A.R.; Vetter, O.J. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 20p. (CONF-810105—3). NTIS, PC A02/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

The overall program and the four experimental fracture stimulation treatments completed to date are described. The GRWSP is organized into two phases. Phase I consists of studies (literature and theoretical), laboratory investigations, and numerical work. Phase II will include the planning, execution and evaluation of six well stimulation treatments which utilize the technology developed in Phase I. Two stimulation experiments were performed at the Raft River, Idaho, Known Geothermal Resource Area (KGRA) in late-1979. This is a naturally fractured, hard rock reservoir with a relatively low geothermal resource temperature (300°F). A conventional planar hydraulic fracture job was performed in Well RRGP-5 and a Kiel dendritic (or reverse flow) technique was utilized in Well RRGP-4. In mid-1980, two stimulation experiments were performed at the East Mesa, California, KGRA. The stimulation of Well 58-30 provided the first geothermal well fracturing experience in a moderate temperature (350°F+) reservoir with matrix type rock properties. The two treatments consisted of a conventional hydraulic fracture of a deep, low permeability zone and a minifrac Kiel treatment of a shallow, high permeability zone in the same well. The stimulation experiment results to date were evaluated using short-term production tests, conventional pressure transient analysis, interference pressure data, chemical and radioactive tracers, borehole acoustic televiewer surveys, and numerical models.

10780 **(LBL—11498) Theoretical assessment of James' method for the determination of geothermal wellbore discharge characteristics.** Karamarakar, M.; Cheng, P. (Hawaii Univ., Manoa (USA). Dept. of Mechanical Engineering). Nov 1980. Contract W-7405-ENG-48. 25p. (GREMP—12). NTIS, PC A02/MF A01.

A theoretical study based on two-phase critical flow models has been performed to evaluate James' empirical method for the determination of geothermal wellbore discharge characteristics. The following conclusions are obtained: the James' empirical method for the determination of stagnation enthalpy, steam quality, and total flow rate are within 8% from results predicted from one-component two-phase critical flow models of Fauske, Moody, and Levy. When the wellbore discharge contains a substantial amount

of CO_2, the determination of discharge characteristics based on the modified James' method agree with those predicted based on a modification of Fauske's model to the same degree of accuracy. An extension of Fauske's theory shows that if a large amount of dissolved salts exists in the discharge, the straight-forward application of James' method for the determination of discharge characteristics will lead to serious errors. When the lip pressure is low and the discharge pipe diameter is equal to or larger than 6-inches in diameter, the pressure gradient in the approach region of the critical flow is small such that the lip pressure measurements taken within 1/4-inch from the exit would not affect the accuracy of the determination of the critical flow rate.

10781 **(SAND—80-1704C) Drill pipe corrosion control using an inert drilling fluid.** Caskey, B.C.; Copass, K.S. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 57p. (CONF-810105—4). NTIS, PC A04/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

The results of a geothermal drill pipe corrosion field test are presented. When a low-density drilling fluid was required for drilling a geothermal well because of an underpressured, fractured formation, two drilling fluids were alternately used to compare drill pipe corrosion rates. The first fluid was an air-water mist with corrosion control chemicals. The other fluid was a nitrogen-water mist without added chemicals. The test was conducted during November 1980 at the Baca Location in northern New Mexico. Data from corrosion rings, corrosion probes, fluid samples and flow line instrumentation are plotted for the ten day test period. It is shown that the inert drilling fluid, nitrogen, reduced corrosion rates by more than an order of magnitude. Test setup and procedures are also discussed. Development of an onsite inert gas generator could reduce the cost of drilling geothermal wells by extending drill pipe life and reducing corrosion control chemical costs.

10782 **(SAND—80-2702C) Recent developments in geothermal drilling fluids.** Kelsey, J.R.; Rand, P.B.; Nevins, M.J.; Clements, W.R.; Hilscher, L.W.; Remont, L.J.; Matula, G.W.; Bailey, D.N. (Sandia National Labs., Albuquerque, NM (USA); NL Baroid, Inc., Houston, TX (USA)). 1981. Contract AC04-76DP00789. 22p. (CONF-810105—5). NTIS, PC A02/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

Three recent development efforts are described, aimed at solving some of these drilling fluid problems. The Sandia aqueous foam studies are still in the laboratory phase; NL Baroid's polymeric deflocculant is being field tested; and the Mudtech high temperature mud was field tested several months ago. The aqueous foam studies are aimed at screening available surfactants for temperture and chemical stability. Approximately 100 surfactants have been tested at temperatures of 260°C and 310°C and several of these candidates appear very promising. A polymeric deflocculant was developed for water-based muds which shows promise in laboratory tests of retarding thermal degradation effects and associated gelation. Formulations containing this new polymer have shown good rheological properties up to 500°F. A high temperature mud consisting primarily of sepiolite, bentonite, and brown coal has been developed. A field test of this mud was conducted in a geothermal well in the Imperial Valley of California in May of last year. The fluid exhibited good hole-cleaning characteristics and good rheological properties throughout the test. (MHR)

10783 **Apparatus for realization of rock exploitation method based on thermodynamic cycles utilizing in situ energy source.** Aladiev, I.T.; Fardzinov, V.K.; Gukov, G.P.; Saperov, E.V.; Voskresensky, K.D. US Patent 4,220,202. 2 Sep 1980. Filed date 15 Apr 1976. vp.

An apparatus for the realization of a rock-exploitation method based on thermodynamic cycles utilizing an in-situ energy source including a well with a casing sunk at least as far down as a producing horizon, a string of exploitation pipes having at least one opening at the fluid outlet, and means for varying the heat content of the heat-carrying agent in one of the zones of the thermodynamic cycle of interaction with stratal fluid.

10784 **Heat and mass transfer with phase conversion in porous media application to geothermal reservoir simulation.** Bories, S.; Podaire, A. pp 680-693 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

Heat and mass transfer in the presence of phase change in porous media play a very important role in the production of hydrothermal reservoirs. After a literature review of this field the equations describing heat and mass transfer are presented and used to derive dimensionless quantities governing the phenomena. Recent numerical modelling of these equations are also analyzed and discussed. A physical model designed to simulate linear unsteady two phase flow during a self vaporization process without or with reinjection of condensed fluid is presented. In the case of no reinjection the experimental results have confirmed the validity of lumped-parameter model to describe the global behaviour of an homogeneous geothermal reservoir during exploitation. For the case with reinjection only qualitative results showing the possible interest of this procedure for stimulated vapor dominated reservoirs are presented. Concerning the numerical approach a distributed parameter model or local model has been developed to simulate the unsteady two phase flow in a unidirectional case. Results showing the evolution of the phase change zone are presented.

10785 **Lifetime optimization of low enthalpy geothermal doublets.** Sauty, J.P.; Gringarten, A.C.; Landel, P.A.; Menjoz, A. pp 706-719 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The number of doublets exploiting geothermal energy is rapidly increasing: they protect the reservoir supply of water and eliminate the warm and generally salty residual water from ground surface, by reinjection into its original formation. This device, however, has the inconvenience of developing a cold body which after some time reaches the production well, thus lowering the production water temperature. Prevention of this breakthrough is of great economic importance as it limits the doublet lifetime. Using mathematical models, the influences of the physical characteristics of the reservoir on this lifetime were studied. The influence of each factor yields general type curves, with dimensionless variables. On the other hand,. small scale doublets in the field were explored (13 meters between wells) in order to verify the physical hypotheses on which the forecast models are based. An example is given of application of the results thus obtained to the prediction of the behavior of a doublet operated on the Parisian Basin Dogger. Finally, these results are discussed from the standpoint of the optimization of the lifetime of low enthalpy geothermal doublets.

10786 **In situ determination of the hydrothermal properties of a deep fractured medium by a single well technique.** Hosanski, J.M.; Ledoux, E. (Centre d'Informatique Geologique, Fontainebleau, France). pp 747-755 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

A simple method is described of in situ analyzing of a slightly fissured medium, developed in the course of the experiments carried out at the site of Mayet de Montagne (Allier, France) in December 1978. The experiments had a twofold purpose: (1) identification of the physical phenomena governing the heat exchange between the slightly fissured medium and the injected fluids; and (2) determination in situ of the parameters which control this exchange. When this was accomplished, the next step was to build a digital model to predict the behavior of a hydrothermal doublet in a fissured medium.

10787 **Well testing of low to very low permeability fractured media: a review.** Feuga, B.; Noyer, M.L.; Thiery, D. pp 756-781 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

A constant rate pumping method for which new solutions have been derived has been tested at Le Mayet de Montagne (France) experimental HDR field. This method has been compared with a frequency based water test method, in order to delineate the fields of application of each of them.

10788 **Hydraulic fracturing of hot dry rocks. Tridimensional studies of cracks propagation and interaction by photoelastic methods.** Camponuovo, G.F. (ISMES, Bergamo, Italy); Freddi, A.; Borsetto, M. pp 947-956 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The feasibility of a heat-exchanger in Hot Dry Rocks (Commission of European Communities Project) has been analyzed by experimental and numerical tests on propagation and interaction of pressurized 3D cracks in elastic medium. After visualization of front evolution in transparent models, the fracture mechanics parameters in different configurations at various stages of propagation were evaluated by 3D photoelasticity, holography and finite element techniques.

10789 **Scale models studies of well linking by hydraulic fracturing and fatigue microfracturing.** Lessi, J.; Sarda, J.P. pp 957-966 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

Stress analysis shows that, considering an impermeable solid, it is theoretically possible to connect two hydraulic fractures developed from two wells. This possibility has been studied on physical models. The suitable mechanical properties of the model were deduced from the theory. A few experiments show that the fracture can be connected in model conditions corresponding to isotropic in situ stresses. It was not possible to improve permeability by pore pressure cycles.

10790 **Microseismic and acoustic activity associated with hydraulic fracture propagation.** Cornet, F.H. pp 967-976 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

Seismic and acoustic sources activated by the development of hydraulic fractures are discussed. It is shown that acoustic activity associated with crack extension should be high frequency; its existence depends upon pressure distribution at crack tip. For permeable fractured material, the increment in pore pressure in the vicinity of the hydraulic fracture may lead to some local slips which, in turn, can generate signals. The frequency spectrum of these signals depends on the amount of injected volume and injection duration. In situ experiments carried out to investigate the possibility of mapping this activity in order to determine orientation and extent of a hydraulic fracture are presented. By comparison with previously published results, it is concluded that hydrophones are not appropriate for monitoring this type of acoustic activity. Further no low frequency induced seismicity has been observed although up to 12 m^3 meters have been injected. It is proposed that only three component high frequency geophones (linear response up to 5000 Hz) tightly coupled with the rock in deep boreholes should be used for this type of investigation.

10791 **Permeability stimulation of crystalline rocks by chemical leaching.** Sarda, J.P.; Roque, C. pp 977-988 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The chemical leaching of quartz bearing crystalline rocks were studied at pressure and temperature conditions. After preliminary tests the study was focused on soda solutions. From laboratory flow experiments through a fracture it was observed that, at 200°C, the soda solutions increase the permeability of the fracture faces. Silica is specifically dissolved when ethanol is added to the solution. The rock strength remains high enough to sustain the stresses and to preserve the permeability.

10792 **Heat fracturing physical model.** BouilleaU, M.; Berthomieu, G.; Jouanna, P. (Universite des Sciences et Techniques du Languedoc, Montpellier, France). pp 989-993 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The stability of a deep fracture under the influence of thermal factors is a controversial question. Although theoretical approaches exist, there is no doubt that the physico-chemical complexity of this problem leaves wide scope for an experimental approach. The purpose of this study is to perfect test apparatus for rock samples which will be placed as close as possible to the conditions encountered in the neighborhood of a fracture located at a great depth and destined to be used as an exchanger in a hot dry rock environment. This contribution gives a detailed description of this test apparatus and the main performances to be expected of it.

10793 **Experience with Frac treatment in deep low permeability gas reservoirs.** Fuhrberg, H.D.; Brinkmann, F.; Schoeber, K. pp 994-1008 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980). (In German)

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The change in the energy market since 1973 has led to an intensified development of deep low-permeable reservoirs by means of Massive Hydraulic Fracturing (MHF). Planning of this type of stimulation is based on a thorough knowledge of petrophysical and petrographical parameters. These criteria and the analyses of proppants and fluids successfully applied in deep Carboniferous and Rotliegend wells are described. A rough comparison between increase of capacity and treatment costs indicates that further treatments are justified. Proposals are being made for an improvement of treatment design, treatment performance, and evaluation methods.

10794 **Enhancement of the permeability of granite by explosive and hydraulic fracturing.** Batchelor, A.S.; Pearson, C.M.; Halladay, N.P. (Camborne School of Mines, England). pp 1009-1031 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

Geothermal energy is potentially available from rock at elevated temperatues in the Earth's crust but which lacks circulating fluids to transport the energy to the surface. This resource has become known as the Hot Dry Rock energy source. Two alternative extraction concepts have been proposed and this paper details the results of a field experiment designed to stimulate many fractures at the wellbore. Unfocused explosive changes were used to produce optimum radial fracture patterns that could then be enhanced by hydraulic stimulation. The resulting system is extremely complex but the results indicate that this combination of fracturing techniques is essential to overcome the strength and impermeability of the granite fabric.

10795 **Analysis of hydraulic fracture propagation: a field experimentation.** Cornet, F.H. (Univ. of Paris, France). pp 1032-1043 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

Numerical results and laboratory work on hydraulic fracture propagation is first briefly recalled. It is shown that fracture orientation depends upon in-situ stress state, injection flowrate and rock

mass resistance anisotropy. Field results are presented which illustrate the applicability of these results to granitic rock masses. A new stress measuring method based on shut-in pressure measurements conducted for fractures developed in various orientations, is presented; dispersion of results derived from 8 fractures is within 3 bars. This stress determination has been used to compute the orientation of a propped hydraulic fracture away from the injection well. Intersection of this fracture with a second borehole, drilled 30 m away from the first one, demonstrated the accuracy of the determination.

10796 **Investigations on an artificially created frac in a shallow and low permeable environment.** Kappelmeyer, O.; Rummel, F. pp 1044-1053 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

A test site for Hot Dry Rock experiments was installed in cristalline rocks near Falkenberg in northeast Bavaria. Three seismic detection holes situated at the corners of a triangle with 100 m side length and an operation hole in the center of this triangle were drilled to 300 m depth. The total hole sections were cored and analyzed regarding natural fissures and cracks. The rock permeabilities, the natural stress field and other rock properties were determined. Well logging was performed and the results correlated with fissures, fracs and alterated zones from the core sections. In the operation hole in 158 m and 255 m depths fracs were created by hydraulic fracturing. Break down pressure in 255 m depth was 20.5 M Pa the fluid volume in this frac is about 3 m^3, water recovery was about 40%. During the frac opening acoustic events were created and observed with three component well geophones in the observation holes. The interpretation of the seismic events provided a model of the frac extension which was used to localize two intersection holes each 15 m east and west of the operation hole. The western intersection hole cut a frac in 260 m depth which appears to be the hydraulic frac.

1510 Direct Energy Utilization

10797 **(DOE/ET/27256—T8) Direct utilization of geothermal energy: a layman's guide. Geothermal Resources Council special report No. 8.** Anderson, D.N.; Lund, J.W. (eds.). (Geothermal Resources Council, Davis, CA (USA); Oregon Inst. of Tech., Klamath Falls (USA). Geo-Heat Utilization Center). 1979. Contract FG06-79ET27256. 101p. NTIS, PC A06/MF A01.

The following subjects are covered: nature and distribution of geothermal energy; exploration, confirmation, and evaluation of the resource; reservoir development and management; utilization; economics of direct-use development; financing direct-use projects; and legal, institutional, and environmental aspects. (MHR)

10798 **(DOE/ET/27256—T9) Direct utilization of geothermal energy: a technical handbook.** Anderson, D.N; Lund, J.W. (eds.). (Geothermal Resources Council, Davis, CA (USA); Oregon Inst. of Tech., Klamath Falls (USA)). 1979. Contract FG06-79ET27256. 249p. NTIS, PC A11/MF A01.

This technical handbook includes comprehensive discussions on nature and occurrence of the geothermal resource, its development, utilization, economics, financing, and regulation. Information on pricing parameters for the direct use of geothermal energy is included as an appendix. (MRH)

10799 **(DOE/ID/12049—3) Municipal geothermal heat utilization plan for Glenwood Springs, Colorado.** (Denver Univ., CO (USA)). 31 Dec 1980. Contract AS07-79ID12049. 276p. NTIS, PC A13/MF A01.

A study has been made of the engineering and economic feasibility of utilizing the geothermal resource underlying Glenwood Springs Colorado, to heat a group of public buildings. The results have shown that the use of geothermal heat is indeed feasible when compared to the cost of natural gas. The proposed system is composed of a wellhead plate heat exchanger which feeds a closed distribution loop of treated water circulated to the buildings which form the load. The base case system was designed to supply twice the demand created by the seven public buildings in order to take advantage of some economies of scale. To increase the utilization factor of the available geothermal energy, a peaking boiler which burns natural gas is recommended. Disposal of the cooled brine would be via underground injection. Considerable study was done to examine the impact of reduced operating temperature on the existing heating systems. Several options to minimize this problem were identified. Economic analyses were completed to determine the present values of heat from the geothermal system and from the present natural gas over a 30 year projected system life. For the base case savings of over $1 million were shown. Sensitivities of the economics to capital cost, operating cost, system size and other parameters were calculated. For all reasonable assumptions, the geothermal system was cheaper. Financing alternatives were also examined. An extensive survey of all existing data on the geology of the study has led to the prediction of resource parameters. The wellhead temperature of produced fluid is suspected to lie between 140 and 180°F (60 and 82°C). Flowrates may be as high as 1000 gpm (3800 liters per minute) from a reservoir formation that is 300 ft (90 m) thick beginning about 500 ft (150 m) below the suggested drill site in the proposed Two Rivers Park.

10800 **Demonstruation project: couple of wells for geothermal space heating in Metanopoli, Milano.** Sommaruga, C.; Ghelardoni, R. pp 284-290 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The Po Valley, Italy's largest sedimentary basin is, geothermally speaking, rather cold. Nevertheless, several wells drilled by AGIP for petroleum exploration evidenced areas in which there exist conditions favourable for carrying out space heating projects. In one of these areas, south of Milano, AGIP and SNAM are carrying out the Metanopoli home heating pilot project. It was expected to reach an aquifer at a 2000 m depth containing water at a 65°C temperature and 100 m^3/h flow rate. The drilled well confirmed the existence of such aquifer (1967 m-2114 m) with a 75°C temperature but raised new problems. The presence of natural gas dissolved in water a salt content as high as 88.8 g/l and the aquifer being less thick than expected require solutions before drilling the second well.

10801 **Results of the new geothermal domestic heating system at Creil.** Jaud, P. (Direction des Etudes et Recherches, Chatou, France). pp 782-792 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The geothermal heating system at Creil is one of the first geothermal projects in France, being preceeded by only the geothermal installations of Melun-l'Almont and Villeneuve-la-Garenne. Its design is quite different from other geothermal installations. Its originality is that three heat pumps are used in series with the heat exchangers, in order to maximize the heat extraction from the geothermal water. Measurements made by Electricity of France during an entire season of heating, have given an understanding of the optimum control strategy of the installation and have allowed the thermal and economic performance of the system to be established. This study shows that the geothermal heating system of Creil allowed energy saving without increasing the cost of heating.

10802 **Optimal use of low enthalpy geothermal waters under various climatic conditions. Application to space heating.** Lamethe-Parneix, D. (Direction des Etudes et Recherches, Chatou, France). pp 793-802 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980). (In French)

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

A computer program has been developed to carry out heat, energy and economic balances of the various heating systems using geothermal energy. It was then possible, by numerous runs, to

obtain results in the form of graphics showing the influence of the main parameters on the economy of a geothermal heating project.

10803 **Study and optimization of a high efficiency convector adapted for the use of geothermal low temperature water.** Chevalier, P.; Grossin, R.; Roth, B. pp 803-809 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The development of a new convector adapted to the use of geothermal water for the heating of dwellings is described. This convector uses a vertical duct to improve the velocity of the air through a novel exchanger. The exchanger surface is made of noncommerical finned tubes. Experimentations on a variety of geometries of finned tubes have been made. They have confirmed a simple theory which helps for the optimization of the exchanger surface. The geometry and conduction technology are selected in order to obtain high thermal efficiency and low cost. A study about the aesthetics of the convector preceded the building of a prototype. The characteristics of this prototype are presented in comparison with a conventional convector. This work shows the advantage of the new convector for the use of waters with inlet temperature below 55°C and outlet temperature below 30°C. This makes this product adequate for geothermal heating.

10804 **Geothermal energy for industrial application.** Fulton, R.L. (Lawrence Berkeley Lab., CA). pp Paper 35, 16p of Energy: the new rules. Newman, D.T. (ed.). Santa Monica, CA; Management Education Corporation (1979).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

Worldwide, the use of geothermal energy, not including mineral baths or spas, is approximately evenly divided between electrical generation and non-electric direct heat uses. At present the world geothermal electrical generating capacity is about 1800 MWe, with the US the largest single producer at 608 MWe. The electrical production processes are described briefly. In the US, the amount of industrial process heat used at temperatures below 400°F is about equal to the energy used for residential and commercial space heating and domestic hot water. Designing or adapting a plant for geothermal process heat will most benefit those processes that require large amounts of heat. The use of lower-cost geothermal process heat will have the greatest economic effect on those products that have a larger portion of their cost in heat energy. The large heat-energy intensive industries are: food and products, paper and allied products, chemicals, and petroleum and coal tar products. The cost of geothermal energy will vary depending upon the circumstances of each individual source. (MCW)

10805 **Low temperature geothermal energy applications in the Albuquerque area. Final report, July 1, 1978-August 18, 1979.** Kauffman, D.; Houghton, A.V. Albuquerque, NM; University of New Mexico (1979). 192p. (NP—25234; EMD—78-2122). New Mexico Energy and Minerals Department, Santa Fe.

A study was made of the engineering and economic feasibility of hot water geothermal energy applications in the Albuquerque area. A generalized system design was developed and used as the basis for a series of economic case studies. Reservoir and user siting considerations were studied in light of the economic findings. Several specific potential applications were identified, including university campuses, industrial and commercial facilities, and residential buildings. Specific key technical problems relating to Albuquerque area applications were studied. These included environmental impacts, corrosion, scaling, heat losses in wells and transmission lines, heat exchangers, control systems, and system utilization and reliability. It is concluded that geothermal energy could be competitive with other energy sources for space heating and limited industrial use for moderate to large (10 million Btu/hr or more) energy using systems.

10806 **(DOE/ET/27232—T5) Utilization of geothermal energy in the mining and processing of tungsten ore. Final report.** Erickson, M.V.; Lacy, S.B.; Lowe, G.D.; Nussbaum, A.M.; Walter, K.M.; Willens, C.A. (WESTEC Services, Inc., San Diego, CA (USA)). [nd]. Contract AC03-79ET27232. 242p. NTIS, PC A11/MF A01.

The engineering, economic, and environmental feasibility of the use of low and moderate temperature geothermal heat in the mining and processing of tungsten ore is explored. The following are covered: general engineering evaluation, design of a geothermal energy system, economics, the geothermal resource, the institutional barriers assessment, environmental factors, an alternate geothermal energy source, and alternates to geothermal development. (MHR)

1520 Geothermal Data And Theory

REFER ALSO TO CITATION(S) 10735, 10752

10807 **Refinements in the use of chemical geothermometers application to the Plombieres system (France).** Bittencourt, A. (Parana Univ., Curitiba, Brazil); Fritz, B.; Tardy, Y. pp 340-348 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

Classical and new geochemical thermometers were tested in the thermal waters of the Plombieres system. Twenty five springs, coming out of the cracks of a granitic body at different temperatures, were sampled and analyzed during three years. These waters are of surface origin and are mixed from three reservoirs: (1) a surface reservoir, cold, not polluted, (2) a surface reservoir, cold and slightly polluted, and (3) a deep and hot reservoir. The direct use of the different geochemical thermometers fails and geochemistry of the system should be interpreted in terms of a mixing model. With the aid of this model, the temperature of the hot reservoir is estimated to be 140°C.

10808 **Evaluation of reservoir temperatures in Tuscany by application of a gas-geothermometer.** D'Amore, F.; Panichi, C.; Squarci, P. (GNR, Pisa, Italy). pp 369-377 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

Analysis of the relationship between the main gases from many natural thermal manifestations and from different geothermal boreholes has led to the definition of a new geothermometer based on the analytical composition of CO_2-H_2-S-H_2-CH_4. An attempt was made to apply this gas-geothermometer in the thermal areas of central-southern Tuscany; the results have proved to be of considerable interest for a regional-scale geothermal prospecting and were used to compile a reliable temperature map for deep reservoirs.

10809 **Fluid-rock interaction in geothermal energy recovery.** Althaus, E. pp 378-386 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

Reaction of aqueous fluids with minerals of geothermal energy reservoir rocks produces both secondary solid phases and more or less concentrated solutions. Kind, amount, and rate of reaction are governed by the degree of deviation from equilibrium concentrations. Ionic ratios (metal-to-hydrogen) are the most important parameters for these effects. Heat production from chemical energy is possible in relevant amounts, but involves production of dissolved material. Conditions of optimal operation have to be evaluated individually for each rock system. Ionic concentration and P/ sub H/ can be used to determine the reactivity of solutions.

10810 **In situ determination of thermal conductivity in cased drill holes.** Behrens, J.; Roters, B.; Villinger, H. (Technische Universitaet, Berlin, Germany). pp 525-534 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

Geothermal investigations on the Schwaebische Alb (FRG) have been made in shallow drill holes of about 30 to 40m depth. To get the heat flow, the temperature gradient and the thermal conductivity of the surrounding rock must be known. If no core is available in situ methods for the determination of the thermal conductivity in cased drill holes have to be used. The developed method for in situ determination of thermal conductivity uses the principle of an infinite cylindrical heat source. A separated section of the waterfilled drill hole is heated up with a constant rate of heat input. The temperature rise of the well-mixed water section as a function of the heating time allows the calculation of the theral conductivity. Assumptions and advantages of the used method are discussed. The construction of the probe and first results of in situ measurements carried out with the described device are presented.

10811 **Experimental studies of rock-water interactions occurring during the circulation of a geothermal doublet in a carbonate environment.** Desplan, A.; Leleu, M.; Massard, P.; Rochon, J. pp 735-746 of Advances in European geothermal research. Strub, A.S.; Ungemach, P. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1980).

From 2. international seminar on the results of EC geothermal energy research; Strasbourg, France (4 Mar 1980).

The present study, essentially experimental, concerns the relations between flow and chemistry, the evolution of the reservoir, and the consequence on the life time of the doublet. First, the experimental results permit finding the speed of calcite dissolution and showing in the case of MELUN doublet that dissolution takes place in a very short time after the reinjection. The volume of the reservoir influenced, depends on the heterogeneity of this one. The precipitation, which is only a function of temperature variation, takes place at the thermal front, in all the reservoir, during the life of the doublet. Dissolution open heterogenity, precipitation does not have a great effect on reservoir permeability. A simplified simulation model, shows that the physicochemical phenomena have no effect on the life time of a doublet located in a calcareous reservoir.

16 TIDAL POWER

1608 Wave Energy Converters

10812 **Apparatus for obtaining energy from wave motion.** Mcculloch, G.E. US Patent 4,222,238. 16 Sep 1980. Filed date 14 Aug 1978. vp.

The apparatus is characterized by a first conduit communicating with a fluid-filled first enclosure and has an open end adapted to be immersed in a wave-forming body of fluid for conducting pressure-induced flow toward and away from the first enclosure. A variable volume enclosure is disposed within the first enclosure having its lower wall connected to a structure of variable buoyancy, adapted to expand and contract in conformity with the principles of a "cartesian diver". A second conduit is connected for providing a flow of fluid between the first and the variable volume enclosures, and a motor is connected in the second conduit and adapted to be driven by the fluid flow therein.

10813 **Rotary transducers.** Wells, A.A. (to Queen's Univ Of Belfast (Ireland)). US Patent 4,221,538. 9 Sep 1980. Filed date 11 Nov 1977. vp.

A rotary transducer adapted to be driven in the same direction by air flow therethrough in either axial direction comprises a rotor having blades of aerofoil cross-section which are fixed with their planes of zero lift normal to the axis of the rotor. An apparatus for use in extracting energy from the waves of the sea utilizes such a transducer.

10814 **Review materials aspects of wave energy converters.** Hudson, J.A.; Phillips, D.C.; Wilkins, N.J.M. (AERE, Harwell, Oxfs, Engl). *Journal of Materials Science ;* **15**: No. 6, 1337-1363(Jun 1980).

There is current interest in renewable energy sources and the United Kingdom is favorably located with respect to wave energy. This review describes briefly the device concepts being pursued in the Department of Energy Program and considers the materials aspects of full-scale Wave Energy Converter (WEC) development. Emphasis is placed on generic problems rather than areas specific to individual devices. Present estimates put the cost of WEC development relatively high. Thus, effort in the future will be directed at reducing these costs, particularly those of the main structure and mooring system, and the optimum use of materials will be essential. In certain areas gaps in existing materials technology have been identified and experimental programs initiated. 38 refs.

17 WIND ENERGY

10815 **(AD-A—086506) Navy-New Hampshire wind energy program. Final report 4 Jun-31 Oct 79.** Bortz, S.A.; Budenholzer, R.A.; Carlson, R.D.; Fieldhouse, I.; Kornfeld, J. (IIT Research Inst., Chicago, IL (USA)). Nov 1979. 251p. NTIS, PC A12/MF A01.

This program investigated the potential of the Mt. Washington, New Hampshire area for generating electric power from wind energy as an alternative to fossil fuels. The U.S. Naval Shipyard at Portsmouth, New Hampshire is among those facilities which could benefit initially from successful wind generated power. IIT Research Institute (IITRI) specialists performed the following tasks: (1) Evaluation of New Hampshire's wind energy resources for potential electric power generation using meteorological, topographical, biological and other available information, (2) Assessment of the environmental, social, technical, and other possible barriers to the development of wind energy resources, and (3) Economic evaluation of installing one or more wind turbine-generators to supply power either directly to the Shipyard or to lines of the Public Service Company of New Hampshire which supplies the Shipyard.

10816 **(SERI/TR—751-749) Wind energy systems information user study.** Belew, W.W.; Wood, B.L.; Marle, T.L.; Reinhardt, C.L. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1981. Contract AC02-77CH00178. 278p. NTIS, PC A13/MF A01.

This report describes the results of a series of telephone interviews with potential users of information on wind energy conversion. These interviews, part of a larger study covering nine different solar technologies, attempted to identify: the type of information each distinctive group of information users needed, and the best way of getting information to that group. Groups studied include: wind energy conversion system researchers; wind energy conversion system manufacturer representatives; wind energy conversion system distributors; wind turbine engineers; utility representatives; educators; county agents and extension service agents; and wind turbine owners.

1701 Availability (climatology)

REFER ALSO TO CITATION(S) 10833, 11050

10817 **(DOE/ET/20355—T1) Height projection methods and sensitivity study. Technical report.** Mikhail, A.S.; Justus, C.G. (Georgia Inst. of Tech., Atlanta (USA). School of Geophysical Sciences). Jun 1979. Contract AS06-76ET20355. 92p. NTIS, PC A05/MF A01.

A brief description is given of the different techniques for height projection of wind speed that have been developed at Georgia Tech. One of these techniques, the similarity model, is based on Monin-Obukhov similarity theory. Other models examined are the empirical velocity-dependent power law model (power law model) and the semi-empirical modified velocity-dependent power law model (modified power law model). A detailed description of the methodologies is given and example applications are illustrated, with all the necessary input parameters to the models.

10818 (DOE/EV/73002—1(Vol.3), pp 15.1-15.66) **Wind.** 1980.

In Alaska Regional Energy Resources Planning Project. Phase 2: coal, hydroelectric and energy alternatives. Volume III. Alaska's alternative energies and regional assessment inventory update.

The history of the use of windmills in Alaska is traced. The technology, environmental impacts, and applicability of wind power to rural Alaska are discussed. Tables of wind data obtained at Alaskan locations are included. (MHR)

10819 **(NYSERDA—80-11) High yield wind energy resources in New York State.** Sforza, P.M. (Flowpower, Inc., Huntington Station, NY (USA)). Jun 1980. 173p. NYSERDA, Albany, NY.

An evaluation of high yield wind resources in New York State is presented. Wind speed and direction data from 45 sites around the state, particularly in high potential coastal areas, has been collected and subjected to computer processing for identification of candidate sites for wind energy conversion applications. A detailed assessment of wind turbine performance at the top 10 coastal sites was carried out and the resulting data is presented. An economic analysis of the operation of commercially available wind turbine generators at these sites is then performed and the capital and operating costs listed and discussed, both for individual units and for clusters rated at 10 MW. A description of various financial considerations, such as simple payback period, is also presented. The institutional, environmental, and land use considerations operative in the areas around the top sites are discussed.

10820 **(PNL—3195(WERA-5)) Wind energy resource atlas. Volume 5: the East Central Region.** Brode, R.; Stoner, R.; Elliott, D.L.; Barchet, W.R.; George, R.L. (NUS Corp., Rockville, MD (USA)). 1980. Contract AC06-76RL01830. 214p. NTIS, PC A10/MF A01.

This atlas of the wind energy resource is composed of introductory and background information, a regional summary of the wind resource, and assessments of the wind resource in each state of the region. Background is presented on how the wind resource is assessed and on how the results of the assessment should be interpreted. A description of the wind resource on a regional scale is then given. The results of the wind energy assessments for each state are assembled into an overview and summary of the various features of the regional wind energy resource. Assessments for individual states are presented as separate chapters. The state wind energy resources are described in greater detail than is the regional wind energy resource, and features of selected stations are discussed. This preface outlines the use and interpretation of the information found in the state chapters. States include Delaware, Maryland, Kentucky, North Carolina, Tennessee, Virginia, and West Virginia.

10821 **(PNL-SA—7832) Meteorological and topographical indicators of wind energy for regional assessments.** Elliott, D.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1979. Contract AC06-76RL01830. 12p. (CONF-790665—3). NTIS, PC A02/MF A01.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

Techniques using meteorological and topographical indicators of wind energy, developed by PNL and applied to the Northwest wind resource assessment, improved the reliability of the analysis of the geographical distribution of wind energy. The identification and application of these indicators led to an improved understanding of the conditions associated with high and low wind energy. Furthermore, these indicators are especially useful in complex terrain and wind-data-sparse areas for obtaining a somewhat realistic estimate of the wind energy resource.

10822 **(PNL-SA—7966) Review of gust model concepts.** Powell, D.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1979. Contract AC06-76RL01830. 21p. (CONF-7909167—2). NTIS, PC A02/MF A01.

From IEA expert meeting; Boone, NC, USA (26 Sep 1979).

Within the past two years Pacific Northwest Laboratory (PNL) has been associated directly or indirectly with several documents in which the authors set forth their concept of a wind component gust model. In this paper three models, each representing a somewhat different concept, are reviewed. A gust model can be defined as a mathematical model that begins by describing wind fluctuations in terms of discrete events and ends by defining statistics of those events. In the present models, all wind fluctuation is described in terms of either individual wind components with respect to a Cartesian coordinate system at a single point, or volume averages of these wind components.

10823 **Meteorological aspects and wind energy: assessing the resource and selecting the sites.** Pennell, W.T.; Barchet, W.R.; Elliott, D.L.; Wendell, L.L.; Hiester, T.R. (Battelle, Pac Northwest Lab, Richland, Wash). *Journal of Industrial Aerodynamics ;* **5**: No. 3-4, 223-246(May 1980).

Research on wind characteristics within the United States' wind energy program is addressing problems of resource assessment, site selection, design and performance evaluation of wind machines, and day-to-day operations of wind energy conversion systems (WECS) in utility grids. In this paper, work designed to improve understanding of the wind energy resource within the United States is discussed. The techniques and procedures that have been developed for finding wind machine sites are also examined. 15 refs.

1704 Economics

10824 (CONF-8009108—, pp 81-91) **Wind energy conversion.** Ankrum, T. 1980.

From Alternate sources of energy conference; New York, NY, USA (29 Sep 1980).

The economics and market potential in the US for large and small wind turbines are analyzed.

1705 Environmental Aspects

REFER ALSO TO CITATION(S) 10467, 11598

10825 (CONF-800334—(Vol.2), pp 209-227) **Television reception near the wind turbine on Block Island, RI.** Sengupta, D.L.; Senior, T.B.A. (Univ. of Michigan, Ann Arbor). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

1706 Wind Energy Engineering

10826 **(DOE/BP/10552—17) Wind energy integration study.** (USDOE Bonneville Power Administration, Portland, OR). Aug 1980. Contract AC79-79BP10552. 77p. NTIS, PC A05/MF A01.

The overall objective of this study was to investigate the feasibility of integrating a simulated 3000 megawatt (MW) wind energy conversion network into the Pacific Northwest hydro-thermal generation system. The specific purpose was to identify those significant effects which require planning consideration and further study prior to extensive development of wind energy. The following areas were identified for preliminary analysis: seasonal power planning (regulation); secondary energy (surplus); energy reserve planning; peak reserves; and hourly planning.

10827 **(DOE/ET/20280—2) Preliminary user's guide for the SIGMET mesoscale meteorology code. Special report, 15 June 1977-15 June 1978.** Patnaik, P.C. (Science Applications, Inc., La Jolla, CA (USA)). Jun 1979. Contract AC06-77ET20280. 142p. NTIS, PC A07/MF A01.

The SIGMET mesoscale meteorology simulation code represents an extension, in terms of physical modelling detail and numerical approach, of the work of Anthes (1972) and Anthes and Warner (1974). The code utilizes a finite difference technique to solve the so-called primitive equations which describe transient flow in the atmosphere. The SIGMET modelling contains all of the physics required to simulate the time dependent meteorology of a region with description of both the planetary boundary layer and

upper level flow as they are affected by synoptic forcing and complex terrain. The mathematical formulation of the SIGMET model and the various physical effects incorporated into it are summarized.

10828 **(DOE/ET/29246—T1) Variable speed constant frequency constant voltage alternator. Annual report.** Grannemann, W.W.; Yang, C.E.; Seo, P.H. (New Mexico Univ., Albuquerque (USA). Coll. of Engineering). Jul 1980. Contract AC01-79ET29246. 41p. NTIS, PC A03/MF A01.

A test alternator is operated with digital control of its output frequency for variable shaft speed. The machine is a two-pole alternator with power removed through slip rings. The output frequency of the alternator is controlled by rotating the field by stepping through sixteen coils around the rotor. Usually four coils are active at one time. The rotating field in the stationary coils of the stator is controlled by microcircuits. The control circuits are constructed with available low-cost, low-power integrated circuits (ICs). The test results from the first test alternator indicate the feasibility of using this type of alternator to convert available wind power directly to usable 60 hertz power.

10829 **(DOE/R5/10125—1) Small sewage lagoon enhancement project.** (Grand Valley State Coll., Allendale, MI (USA)). 1979. Contract FG02-79R510125. 6p. NTIS, PC A02/MF A01.

The intent was to apply simple, existing technology to enhance the efficiency of a small, overloaded sewage lagoon system. If successful, the technique employed could be used by small communities and by food processing plants in northern states to alleviate a serious environmental problem with a low expenditure of energy and reduced costs for capital, maintenance, and operation. The problem originates from low rates of bacterial degradation of organic wastes during winter months, resulting in complaints about odor during spring and fall turnover times. The proposed solution involves raising water temperature in sewage lagoons by insulating the surface and adding heat provided by wind-turbine powered resistance heaters immersed in the lagoons. Thus small lagoon systems at cold weather sites could accommodate increased loads without expanding the size of the system or investing in prohibitively costly aeration systems. The proposal presented estimated costs demonstrating that the lagoon in Allendale could be treated by the new method at an annual savings of 65,000 kilowatt hours and with recovery of added capital investment in two years compared with the aeration method. Beyond that point a savings in operating costs of $2000 to $3000 annually could be realized (based on present costs for electricity.)

10830 **Wind energy in agriculture: quick bibliography series, January 1970-December 1979. Part I. 48 citations. Part II. 122 citations.** Beltsville, MD; National Agriculture Library (1980). 35p. (NP—25214).

Bibliographies in this series are derived from computerized on-line searches of selected data bases. Timeliness of the topic and evidence of extensive interest are selection criteria. Comprehensive subject coverage is not an objective; however, the citations provide a substantial recent resource for investigation of the subject. Each bibliography is updated or dropped after six months.

10831 **(NYSERDA—80-16) Lebost Wind Turbine experimental program at New York University.** (New York Univ., NY (USA). Dept. of Applied Science). May 1980. 53p. New York State Energy Research and Development Authority, Albany.

An experimental program on a full scale Lebost Wind Turbine (LWT)-heat brake system has been performed and is reported. Performance and cost characteristics of such a wind energy conversion system are assessed. Both technological and cost-effectiveness considerations are discussed for this system with emphasis on developing appropriate economic measures for residential and commercial space heating. A cost-effectiveness analysis is developed for target costs per unit frontal area for such a system showing the influence of annual mean windspeed, tower height, atmospheric boundary layer stability, capital-cost financing rates, and the inflation rate of the fossil fuel displaced. The latter two parameters are particularly sensitive ones in assessing both lifetime cost-effectiveness and payback time. Although allowable costs vary by several orders of magnitude, depending on assumptions, for cost-effectiveness, initial target costs of the order of $100 to $400/m^2 of frontal area seem feasible and fairly realistic at this time.

10832 **(PB—80-190838) Novel electric generation schemes for wind power plants, ACCG and DOIG, Part I: executive summary.** Jayadev, T.S. (Wisconsin Univ., Milwaukee (USA). Dept. of Electrical Engineering and Computer Science). 30 Jul 1976. 26p. NTIS, PC A03/MF A01.

Two novel electric generation schemes for wind power plants are evaluated: an A.C. Commutator Generator (ACCG) and the Rotor Fed Induction Generator. The report presents experimental and analytical results and conclusions which include technical information and cost data. ACCG is a machine similar to the d.c. machine and has similar performance characteristics. Although there are no limitations on the use of this machine for wind power generation, the cost coupled with lack of a U.S. manufacturer severely limits its potential for use in variable speed contact frequency generation. Research on the Rotor Fed Induction Generator led to a power electronic circuit connected to the rotor circuit which operates as a generator with broad power vs. speed characteristics. This is applicable to wind energy systems in which speed variation is about 30-40 percent. This system can also regenerate power that would be dissipated. By this means, power output is obtained from both reactor and rotor. The machine thus devised is called a Double Output Induction Generator (DOIG). DOIG is the best choice for wind energy systems. A chart compares variable speed constant frequency generators.

10833 **(PNL-SA—7831) Wind direction variations in strong winds.** Doran, J.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1979. Contract AC06-76RL01830. 9p. (CONF-790665—5). NTIS, PC A02/MF A01.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

Significant differences exist between the angular fluctuations experienced at a fixed point, averaged over a disk of rotation, and those felt by a blade element rotating about a horizontal axis. The static and dynamic descriptions of these fluctuations are an important aspect in design considerations and in the development of tracking strategies. Several methods of description and interpretation have been presented here, but further development is clearly required for a comprehensive picture of wind direction fluctuations.

10834 **(PNL-SA—7833) Status of the large wind turbine handbook.** Heister, T.R.; Pennell, W.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1979. Contract AC06-76RL01830. 13p. (CONF-790665—4). NTIS, PC A02/MF A01.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

The site-selection strategy presented here and in the LWH is conservative, partially because utilities are conservative. They should be. The large-scale generation of electricity by wind turbine generators is an unproven technology. It is assumed that wind characteristics at a site will have to be thoroughly documented. This is because the nature of the wind at the site not only governs the energy output of the WECS farm, but also affects the service life of the wind equipment and both scheduled and unscheduled maintenance costs. Perhaps as experience is gained, the site-selection process can be simplified. Certain steps may be found unnecessary, or requirements on the quantity and quality of wind data collected at each step may be relaxed; however, at this stage of wind energy development, a conservative approach seems prudent.

10835 **(PNL-SA—7965) Siting technologies for large wind turbine clusters.** Hiester, T.R.; Pennell, W.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1979. Contract AC06-76RL01830. 23p. (CONF-7909167—3). NTIS, PC A02/MF A01.

From IEA expert meeting; Boone, NC, USA (26 Sep 1979).

Site selection for large wind turbine clusters requires thorough documentation of the wind characteristics at the site, because of the influence these characteristics will have on the economics,

operations, and service life of the wind turbines. The wind prospecting strategy can be used by a utility to determine specific locations for each wind turbine in a cluster of 10 to 50 or more machines. The key to site selection is knowing what and where to measure. Siting techniques to be used at the various stages of the wind-prospecting strategy are discussed. These techniques help determine where to measure. What to measure at a site is still a moot question. Suggestions are made on what data are needed at what sampling rates. These are based on the assumption that until further experience in siting large clusters of wind turbines is in hand, thorough documentation of wind characteristics affecting machine and cluster output characteristics, operation strategies, and service life are necessary.

10836 **(SAND—80-2407) Computer subroutine for estimating aerodynamic blade loads on Darrieus vertical axis wind turbines.** Sullivan, W.N.; Leonard, T.M. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 36p. NTIS, PC A03/MF A01.

An important aspect of structural design of the Darrieus rotor is the determination of aerodynamic blade loads. This report describes a load generator which has been used at Sandia for quasi-static and dynamic rotor analyses. The generator is based on the single streamtube aerodynamic flow model and is constructed as a FORTRAN IV subroutine to facilitate its use in finite element structural models. Input and output characteristics of the subroutine are described and a complete listing is attached as an appendix.

10837 **Wind conversion lattice array, with multiple miniturbo-generator modules.** Kelly, D.A. US Patent 4,220,870. 2 Sep 1980. Filed date 22 Jun 1978. vp.

The wind conversion lattice array, with multiple, miniturbo/generator modules consists of multiple miniature turbine wind generator modules which are uniformly mounted on an open latticelike framework structure on a building rooftop or other suitable raised structure. The identical turbine impellers are multi-vaned units of about 6 inches to ten inches in diameter, and directly coupled to matching miniature D.C. Electric generators or dynamos located directly above each turbine impeller. Each of the turbo/generator modules is mounted on the horizontal members of the lattice framework structure. Any number of turbo/generator modules may be utilized on the lattice framework, up to about one hundred units for practicality, with the framework oriented in any direction to suit rooftop conditions. The framework is hinged at the base for quick lowering during violent storm conditions, and held in an upright position by folding, diagonal arms.

10838 **Wind-tunnel simulation of thw flow over hills and complex terrain.** Meroney, R.N. (Colo State Univ, Fort Collins). *Journal of Industrial Aerodynamics ;* **5**: No. 3-4, 297-321(May 1980).

A study has been completed to evaluate the accuracy of a wind tunnel investigation of flow over a complex terrain model. Both terraced and contoured models of the Rakaia River Gorge region of New Zealand were prepared to an undistorted geometric scale of 1:5000. The contoured model was examined for three separate surface roughness conditions. On two spring days, selected for strong adiabatic down valley wind flow, three teams of investigators surveyed up to 27 sites on either side and within the river gorge. Measurements consisted of wind speed and direction at a 10 m height. The laboratory simulation results were compared with the available field data by means of statistical correlation and scatter diagrams. The model and field results have been used to assess the value of laboratory experiments as part of a strategy to develop and demonstrate efficient and economical techniques for identifying favorable wind energy conversion sites. 20 refs.

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 10120, 10121, 10220, 10229, 10479, 10594, 10882, 10958, 10962, 11077, 11080, 11084, 11085, 11099, 11099, 11103, 11122, 11123, 11124, 11125, 11126, 11217, 11558, 11589

10839 (CONF-800334—(Vol.1), pp 207-228) **Fluidized-bed combustion development: an overview.** Buck, W.L. (Argonne National Lab., IL); Huang, H.S.; Hubble, B.R.; Bliss, C. Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

A comprehensive assessment of the developmental status of coal-fired FBC technology for electric-power generation has recently been completed, employing a systematic methodology developed by the Metrek Division of The MITRE Corporation. Based on analysis of the 115 individual papers presented at the Fifth International Conference on Fluidized-Bed Combustion (FBC) held in December 1977, in Washington, DC, the assessment depicts the status of information for each element of the technology and identifies the major issues, problems, and information gaps that need to be addressed. A full report on this study, prepared jointly by The MITRE Corporation and Argonne National Laboratory has been published. Only a brief description of the methodology and summary of the results is presented in this paper. The issues, problems, and information gaps identified in the course of this study serve a dual purpose. They are an essential element in the characterization of the present developmental status of FBC technology. They point to those areas of the technology wherein future research, development, and demonstration activities may most profitably be concentrated. Despite their importance, it is not feasible to enumerate and discuss each of the approximately 50 issues and problems and 45 information gaps brought to light during this assessment of the developmental status of FBC technology. Critical elements of uncertainty were revealed in the following areas: fuel and sorbent feeding, combustion efficiency, corrosion and erosion control, sorbent selection and utilization, load-following capability, emission characterization and control, and solid-waste disposal.

10840 (CONF-800334—(Vol.2), pp 665-675) **Grid Connected Integrated Community Energy System environmental effects.** O'Gara, J.C. (Univ. of Minnesota, Minneapolis). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The University's plan to expand its central coal fired steam production included a Department of Energy/University sponsored plan called a Grid Connected Integrated Community Energy System (ICES). The plan involved the purchase, reactivation and retrofit of a retired natural gas fired utility peaking electric generating plant back to coal, addition of cogeneration, sales of electricity to the utility, and addition of steam customers. The methodology of regulatory, community, manufacturer, and process design will allow the plant upon start-up in late 1981 or early 1982 to comply with Federal New Source Performance Standards (NSPS). This paper addresses environmental methodology and design of coal purchases, coal storage, coal handling, ash handling, sulfur dioxide removal, particulate removal, landfilling of waste, add on of customers, cogeneration, and regulatory and community involvement.

10841 **(DOE/ET/15207—T2(Vol.1)) Design and development of Stirling engines for stationary power generation applications in the 500 to 3000 horsepower range. Volume 1. Technical report.** (Advanced Mechanical Technology, Inc., Newton, MA (USA)). 15 Sep 1980. Contract AC02-79ET15207. 294p. NTIS, PC A13/MF A01.

This project was Phase I of a multiphased program for the design and development of Stirling engines for stationary power generation applications in the 500 to 3000 horsepower range. Phase I comprised the conceptual design and associated cost estimates of a stationary Stirling engine capable of being fueled by a variety of heat sources, with emphasis on coal firing, followed by the preparation of a plan for implementing the design, fabrication and testing of a demonstration engine by 1985. The development and evaluation of conceptual designs have been separated into two broad categories: the A designs which represent the present state-of-the-art and which are demonstrable by 1985 with minimum technical risk; and the B designs which involve advanced technology and therefore would require significant research and development prior to

demonstration and commercialization, but which may ultimately offer advantages in terms of lower cost, better performance, or higher reliability. The majority of the effort in Phase I was devoted to the A designs.

10842 **(DOE/ET/15207—T2(Vol.2)) Design and development of Stirling engines for stationary power generation applications in the 500 to 3000 horsepower range. Volume 2. Program plan.** (Advanced Mechanical Technology, Inc., Newton, MA (USA)). 15 Sep 1980. Contract AC02-79ET15207. 56p. NTIS, PC A04/MF A01.

A plan for implementing the proposed state-of-the-art design described in Volume I has been developed. The main objective of the project is to demonstrate a large coal-fired Stirling engine and thus shorten the lead time to commercialization. The demonstration engine will be based on the concepts developed in the first phase of this program, as detailed in Volume I of this report. Thus the proposed program plan is based on the U-4 engine concept fired by a fluidized bed combustor with a two-stage gravity-assisted heat pipe. The plan is divided into five phases and an ongoing supporting technology program. Phase I, Conceptual Design, has been completed. The remaining phases are: Preliminary Design; Final Design; Fabrication; and Testing and Demonstration. The primary target is to begin testing the large coal-fired engine by the fifth year (1985) after the start of Preliminary Design.

10843 **(DOE/RA/20210—3) COSTEAM, an industrial steam generation cost model: updated users' manual.** Murphy, M.; Reierson, J.; Lethi, M.T. (Mitre Corp., McLean, VA (USA). METREK Div.). Oct 1980. Contract AC01-79RA20210. 110p. NTIS, PC A06/MF A01.

COSTEAM is a tool for designers and managers faced with choosing among alternative systems for generating process steam, whether for new or replacement applications. Such a decision requires a series of choices among overall system concepts, component characteristics, fuel types and financial assumptions, all of which are interdependent and affect the cost of steam. COSTEAM takes the user's input on key characteristics of a proposed process steam generation facility, and computes its capital, operating and maintenance costs. Versatility and simplicity of operation are major goals of the COSTEAM system. As a user, you can work to almost any level of detail necessary and appropriate to a given stage of planning. Since the values you specify are retained and used by the computer throughout each terminal session, you can set up a hypothetical steam generation system fixed in all characteristics but one or two of special interest. It is then quick and easy to obtain a series of results by changing only those one or two values between computer runs. This updated version of the Users' Manual contains instructions for using the expanded and improved COSTEAM model. COSTEAM has three technology submodels which address conventional coal, conventional oil and atmospheric fluidized bed combustion. The structure and calculation methods of COSTEAM are not discussed in this guide, and need not be understood in order to use the model. However, you may consult the companion volume of this report, COSTEAM Expansion and Improvements: Design of a Coal-Fired Atmospheric Fluidized Bed Submodel, an Oil-Fired Submodel, and Input/Output Improvements, MTR80W00048, which presents the design details.

10844 **(EPRI-AP—1628) High-reliability gas turbine combined-cycle development program: advanced compressor design study. Final report.** (Westinghouse Electric Corp., Concordville, PA (USA). Combustion Turbine Systems Div.). Nov 1980. 50p. NTIS, PC A03/MF A01.

Results of one task of the first phase of RP1187-2, High-Reliability Gas Turbine Combined-Cycle Development Program are presented. The purpose of this task is to identify and quantify the potential benefits of applying advanced-design, low-aspect ratio, high-throughput compressor technology to heavy-duty power generation combustion turbine engines. Such technology is being used in the aircraft industry with satisfactory performance. This task was undertaken in view of this experience and with the expectation that the adaptation of this technology to electric utility combustion turbine power plants could offer substantial improvements in plant reliability, availability, and maintainability in comparison with units now in service. Included in this task is the development of conceptual designs and performance parameters based on the advanced compressor design approach to provide input to the selection of the best compressor configuration to meet the reliability and efficiency goals set forth for the new engine and combined cycle. The work has progressed with the execution of a literature survey of advanced aircraft technology, low-aspect ratio designs, and the conceptual selection of aerodynamic stage parameters for first, middle, and last stages suitable for the 14:1 compressor pressure ratio requirement. Subsequent analyses identified key mechanical design requirements for blading and rotating elements of the design.

10845 **(EPRI-CS—1626) Engineering evaluation of magma cooling-tower demonstration at Nevada Power Company's Sunrise Station. Final report.** (CH2M Hill, Bellevue, WA (USA)). Nov 1980. 192p. NTIS, PC A09/MF A01.

The Magma Cooling Tower (MCT) process utilizes a falling film heat exchanger integrated into an induced draft cooling tower to evaporate wastewater. A hot water source such as return cooling water (90°F to 110°F) provides the energy for evaporation. Water quality control is maintained by removing potential scaling constituents to make concentration of the wastewater possible without scaling heat transfer surfaces. A pilot-scale demonstration test of the MCT process was performed from March 1979 through June 1979 at Nevada Power Company's Sunrise Station in Las Vegas, Nevada. The pilot unit extracted heat from the powerplant cooling system to evaporate cooling tower blowdown. Two water quality control methods were employed: makeup/sidestream softening and fluidized bed crystallization. The 11-week softening mode test was successful. The unit operated without biofouling or scaling at 100,000 ppM TDS levels under a wide range of operating conditions. Successful operation was not demonstrated in the 10-day crystallization mode test; calcium sulfate ($CaSO_4$) scaling occurred on the last day of the test at a maximum brine concentration of less than 40,000 ppM. An economic and technical comparison with other zero-discharge technologies showed that, for application at Sunrise, the MCT process had competitive capital, operating, and levelized annual costs. No major technical problems were encountered that would preclude the commercial application of a properly designed MCT unit operating in the softening mode.

10846 **(EPRI-CS—1651) Investigation of field test procedures for large fans. Final report.** Gerhart, P.M.; Dorsey, M.J. (Akron Univ., OH (USA). Dept. of Mechanical Engineering). Dec 1980. 103p. NTIS, PC A06/MF A01.

For quite some time there has been no generally accepted procedure for field testing of large fans of the type commonly used to provide mechanical draft in fossil fired steam generating units. The Performance Test Code Committee Number 11 of the American Society of Mechanical Engineers has been working on the development of an acceptable field test procedure for such fans. A fan test code is nearing completion. In order to insure that the test code methods are accurate and practicable and in order to evaluate the feasibility of relatively advanced velocity probes and electronic instrumentation, extensive field tests of two power-plant fans were carried out under the direction of members of PTC-11. Results of the tests indicate that an acceptable procedure for field testing large fans has been developed. This report describes the procedures used and the result of the field tests.

10847 (FE—2215-13(Vol.3), pp 9p, Paper II.32) **Sodium oxide: a corrosive agent in sodium sulfate.** Liang, W.; Bowen, H.K.; Elliott, J.F. (Massachusetts Inst. of Tech., Cambridge). Apr 1979.

In Critical contribu'ions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.

The destructive effects of liquid sodium sulfate deposits on hot gas turbine parts are attributed to the reaction of sodium oxide in the sulfate with the protective oxide on the part: e.g. $(Na_2O) + Al_2O_3(s) = 2(NaAlO_2)$. The activity of Na_2O in the sulfate is given by the reaction $Na_2SO_4(l) = (Na_2O) + SO_2(g) + 1/2\ O_2(g)$. This activity has been measured for a modest range of pressures of SO_2 and O_2 by an emf cell employing β-Alumina as the electrolyte. The effects of additions of contaminants such as Cr_2O_3 and other oxides to the sulfate on the activity of Na_2O has been measured and is reported.

10848 (ORNL/TM—7496) PRODCOST: an electric utility generation simulation code. Hudson, C.R. II; Reynolds, T.M.; Smolen, G.R. (Oak Ridge National Lab., TN (USA)). Feb 1981. Contract W-7405-ENG-26. 85p. NTIS, PC A05/MF A01.

The PRODCOST computer code simulates the operation of an electric utility generation system. Through a probabilistic simulation the expected energy production, fuel consumption, and cost of operation for each plant are determined. Total system fuel consumption, energy generation by type, total generation costs, as well as system loss of load probability and expected unserved energy are also calculated.

10849 Multiple turbine electric power plant having a coordinated control system with improved flexibility. Uram, R. (to Westinghouse Electric Corp). US Patent 4,222,229. 16 Sep 1980. Filed date 18 Oct 1978. vp.

A combined cycle electric power plant includes gas and steam turbines and a steam generator for recovering the heat in the exhaust gases exited from the gas turbine and for using the recovered heat to produce and supply steam to the steam turbine. Afterburners further heat the exhaust gases from each gas turbine prior to their passage to respective heat recovery sections of the steam generator. The power plant control system provides coordinated plant control or coordinated control of selected turbines and afterburners in both startup and load operations, with load distribution optimized according to the turbines under coordinated control. Transfer between coordinated control and alternate modes of plant control may be done by operator selection or automatically upon sensed conditions.

10850 Digital computer system and method for operating a steam turbine with efficient control mode selection. Uram, R. (to Westinghouse Electric Corp). US Patent 4,220,869. 2 Sep 1980. Filed date 8 Mar 1974. vp.

A control system for a steam turbine includes an operator's panel and a programmed digital computer which generates valve position signals for the turbine throttle and governor valves. Mode select signals are generated at the panel and the computer includes a mode selector which provides for structuring the control system to implement external synchronizer, load runback, automatic turbine startup, operator automatic, manual and other mode selections.

10851 Power station. Wenzel, J.O. US Patent 4,220,009. 2 Sep 1980. vp.

A power plant for connection to a main pipe conveying a pressure medium such as natural gas, includes a branch pipe connected to the main pipe, an energy conversion device such as a turbine or a piston pump connected to receive pressure medium from the branch pipe and operable to convert pressure energy of the medium into usable energy, and an intermediate buffer reservoir connected to receive pressure medium from the conversion device and supplying the pressure medium from the reservoir to a load which consumes pressure medium.

10852 High-temperature, coal-fired combustor with ceramic heat exchangers for ccgt systems. Carpenter, H.W.; Campbell, J. Jr.; Russell, L.H.; Wright, D.E. (Rockwell Int, Canoga Park, Calif). *American Society of Mechanical Engineers, [Paper] ;* No. 80-GT-155, vp(1980).

The objective in evaluating Closed Cycle Gas Turbine systems is to convert U.S. coal to electricity with higher efficiency. Higher temperatures are required to accomplish this goal and ceramic heat exchanger surfaces allow the use of working fluid temperatures to 2500 F and higher. The results of a comprehensive government study are described in which an atmospheric fluidized bed and cyclone fired combustor/heat exchanger were designed for operation at 1750 and 2250 F. 8 refs.

10853 Why the proposed new diesel plant. Phillips, J.H. Sebring, FL; Sebring Utilities Commission (1980). 14p. (CONF-800264—4). Library, American Public Power Association, Washington, DC $3.00.

From 24. American Public Power Association annual engineering and operations workshop; Phoenix, AZ, USA (25 Feb 1980).

The experience of the Sebring (Florida) Utilities Commission in investigating very large maritime-type two-cycle diesel engines for supplying additional power capacity to its system is described. Examination of diesel engine power-generating units at several European locations led to the planning of diesel engine facilities which the Commission anticipates will be more reliable, more efficient, and economically competitive than other power production systems. (LCL)

10854 Steam purity monitoring for medium sized utility turbines. Whitehead, A. Lynn, MA; General Electric Company (1980). 7p. (CONF-800264—11). Library, American Public Power Association, Washington, DC $3.00.

From 24. American Public Power Association annual engineering and operations workshop; Phoenix, AZ, USA (25 Feb 1980).

The monitoring of purity levels in steam and water in the overall water treatment-boiler-steam turbine-condensate systems can provide early warnings of potential problems and reduce the likelihood of severe turbine contamination and the associated consequences. These advantages can be obtained at relatively low cost and with no increase in operating personnel. Inert and reactive contaminants and their effects are discussed. Steam sampling and analyzing methods and equipment are described. Steam purity and feedwater chemistry specifications which can contribute to improved turbine reliability and performance are tabulated. (LCL)

10855 Improving the reliability of aging turbine generators. Kessinger, J.P.; Steinebronn, K.A. Lester, PA; Westinghouse Electric Corporation (1980). 28p. (CONF-800264—14). Library, American Public Power Association, Washington, DC $3.00.

From 24. American Public Power Association annual engineering and operations workshop; Phoenix, AZ, USA (25 Feb 1980).

Some of the more critical areas which must be considered when evaluating the future reliability of the turbine generators built in the 1940's and 1950's are discussed. Several of these critical areas have experienced operational difficulty due to a combination of material aging and the stresses produced by the more severe duty imposed during cycling operation. By a combination of improved operating and maintenance procedures, and selected hardware upgrading, however, it is very feasible to significantly extend the life of these turbine generators while at the same time making them more suitable for the types of cycling duty they will likely experience. At the same time it is often possible to improve the operating efficiency of these units and in many cases even obtain significantly increased output with relatively modest hardware modifications.

10856 Conceptual design of a pulverized coal furnace for a utility size closed-cycle, gas-turbine power plant. Strumpf, H.J. (AiRes Manuf Co of Calif, Torrance). *American Society of Mechanical Engineers, [Paper] ;* No. 79-GT-158, 9(1979).

A study has recently been completed for the Department of Energy on the conceptual design of coal-fired, closed-cycle, gas-turbine power plants that operate at high turbine-inlet temperatures and use air as the cycle fluid. This paper describes the design of one type of heater system for such a power plant--a pulverized coal furnace. Designs are presented for a 1550 F (843 C) turbine inlet temperature cycle that utilizes metallic superalloy heat exchanger tubes at a 1750 F (954 C) turbine inlet temperature cycle that utilizes ceramic heat exchanger tubes. The heaters consist of two sections--a radiant section where heat is transferred primarily by radiation from the pulverized coal luminous flame, and a convective section where heat is transferred primarily by forced convection from the nonluminous combustion gas. To maintain flame stability in the furnace, a minimum power density criterion must be met. This requires modularization of the radiant heaters. 3 refs.

10857 Effects of the combustion products of coal-derived fuels on gas turbine hot-stage hardware. Sims, C.T.; Doering, H.v.; Smith, D.P. (GE, Schenectady, NY). *American Society of Mechanical Engineers, [Paper] ;* No. 79-GT-160, 8(1979).

This paper reports a DOE-sponsored program to evaluate the effect of the combustion products of coal-derived fuels on current and potential materials used in gas turbine hot-section compo-

nents and on the plugging of cooling holes in air-cooled airfoils. Atmospheric-pressure small burner rigs and a combustor operating at elevated pressures and design air flows, equipped with a segment of a first-stage nozzle (turbine simulator), were used in these evaluations.

10858 **Pressurized fluidized bed pilot electric plant--a technology status.** Moskowitz, S.; Weth, G.; Leon, A. (Curtiss-Wright Corp, Wood-Ridge, NJ). *American Society of Mechanical Engineers, [Paper]*; No. 79-GT-193, 12(1979).

DOE has sponsored a program to design, construct and operate a pilot electric plant using a pressurized fluidized bed (PFB) combustor burning high sulfur coal to produce electricity. A series of technology tests was conducted to provide corrosion-erosion characteristics of candidate alloys for the PFB heat exchanger tube alloys. Tests for 5000 hr in commercial fluid bed reactors and several thousand hours in laboratory rigs have been conducted on heat exchanger tube specimens using candidate materials of nickel, cobalt or iron base alloys. Alloys suitable for the PFB environment were identified from these tests. A series of tests was also conducted in fluid beds to determine combustion performance and heat transfer film coefficients for the in-bed heat exchanger. Testing in an atmospheric fluidized bed was conducted to obtain the effects of varying fin heights and spacing. A selected fin tube heat exchanger configuration was also tested in a pressurized fluidized bed at temperatures up to 1218 K (1733 F) and pressures up to 55.16 newtons/sq cm (80 psi). The results of these tests are presented. 3 refs.

10859 **Standard coal-fired power plant 500/600 MWe.** Ploss, R. (Gibbs and Hill, Inc., Dallas, TX). pp Paper 24, 337-365 of Energy: the new rules. Newman, D.T. (ed.). Santa Monica, CA; Management Education Corporation (1979).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

A design philosophy for coal-fired power plants which reduces plant costs by using a combination of standard and non-standard modules is presented. Standard module design is recommended for the power block, central control room and plant general auxiliaries. Facilities which are normally constructed only once for a plant site or which must meet site-specific conditions would have non-standard modules. Information is included on plant siting, design criteria, and components of the power block, cooling systems, electrical equipment and control facilities. (LCL)

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10860 **(BNL—51291) Regional Issue Identification and Assessment Program (RIIA). Issue Paper 4. A methodology for analyzing the water quality impacts of cooling-tower blowdown.** Kaplan, E. (Brookhaven National Lab., Upton, NY (USA)). Jul 1979. Contract AC02-76CH00016. 28p. NTIS, PC A03/MF A01.

In a manner similar to that of a boiling teapot, the concentration of substances discharged by a power plant cooling tower (i.e., blowdown) may increase above permissable levels, despite the fact that no additions be made to intake waters. This phenomenon is captured in the design concept referred to as the cooling tower concentration factor, and raises several interesting legal questions. An approximation is presented for the water quality in cooling tower blowdown based upon the concentration factor and a mixing zone comprised of some fraction of the total river flow. The method avoids problems associated with the use of average loading rates. Several examples are given based upon existing and proposed power plant sites. Regulatory ramifications of the concentration phenomenon are discussed in terms of energy facility siting options.

10861 (CONF-800334—(Vol.1), pp 155-174) **Environmental control developments in the direct combustion of low-rank coals.** Talty, R.D.; Ness, H.M. (Grand Forks Energy Technology Center, ND). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The research and development program in environmental control technologies applicable to low rank coal of the Grand Forks Energy Technology Center is described. Four areas are emphasized in this program: flue gas desulfurization in a wet scrubber using low-rank coal fly ash as the absorbent; flue gas desulfurization using dry sorbents; sampling characterizing and control of particulate matter in flue gas of low-rank coal; and characterizing the physical and chemical properties of sludges obtained from the above mentioned wet scrubbing process. These studies are performed in a pilot plant and laboratory as well as in association with low-rank coal fired electric utilities which are testing new environmental control technologies. Results obtained in the 4 areas mentioned above are summarized. Future research plans are discussed. (DMC)

10862 **(PB—80-182876) Overview of the Chalk Point cooling tower project, 1972-1979.** (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). Mar 1979. 173p. NTIS, PC A08/MF A01.

The objectives, methodologies, data, and analytical results of the Chalk Point Cooling Tower Program are reviewed. The overview integrates the concepts and activities of the various program elements to provide a coherent view of the program in its entirety. Samples of the various data acquired are included together with very brief summaries of the conclusions. The report is extensively referenced to provide specific directions to the more extensive treatments of the program, data tabulations, and tape libraries available in the complete library of Chalk Point reports. The Chalk Point data is a resource for the study of cooling tower salt deposition processes and impacts in general. The methods used, while developed to facilitate the assessment of salt drift impact at Chalk Point, also have applicability to cooling tower impact analysis at other sites.

10863 **(PB—80-184385) Survey of flue gas desulfurization systems: Cane Run Station, Louisville Gas and Electric Company. Final report Jul-Dec 78.** Laseke, B.A. Jr. (PEDCO-Environmental, Inc., Cincinnati, OH (USA)). Aug 1979. 172p. NTIS, PC A08/MF A01.

The report gives results of a survey of operational flue gas desulfurization (FGD) systems on coal-fired utility boilers in the U.S. The FGD systems installed on Units 4, 5, and 6 at the Cane Run Station are described in terms of design and performance. The Cane Run No. 4 FGD system is a two-module (packed tower) carbide lime scrubber, retrofitted on a 178 MW (net) coal-fired boiler. The system, supplied by American Air Filter, commenced initial operation in August 1976. The Cane Run No. 5 FGD system is a two-module (spray tower) carbide lime scrubber, retrofitted on a 183 MW (net) coal-fired boiler. The system, supplied by Combustion Engineering, commenced initial operation in December 1977. The Cane Run Unit 6 FGD system is a two-module (tray tower) dual alkali (sodium carbonate/lime) scrubber, retrofitted on a 278 MW (net) coal-fired boiler. The system, supplied by A.D. Little/Combustion Equipment Associates, commenced initial operation in December 1978.

10864 **Process for removing SOx and NOx compounds from gas streams.** Hass, R.H. (to Union Oil Co of California). US Patent 4,222,991. 16 Sep 1980. Filed date 18 May 1978. vp.

A process is given for removing SOx pollutants from a stack gas by (1) absorbing the SOx pollutants with an aqueous absorbent containing a formate compound and (2) regenerating the spent absorbent containing dissolved sox compounds by contact, in the presence of added formate anion, with a water-insoluble, solid substance containing one or more tertiary amine functional groups. Nitrogen monoxide is removed by providing an aqueous absorbent of an iron(II) chelate, such as a chelate of ferrous ion with ethylenediaminetetraacetic acid. Regeneration of spent absorbent containing absorbed no is accomplished under the same conditions as for spent absorbents containing absorbed sox compounds. Sox and no pollutants dissolved in the absorbent are, during regeneration, converted to sulfur and nitrogen without the discharge of waste solids.

10865 **Removal of noxious contaminants from gas.** Gresch, H.; Holter, H.; Igelbuscher, H. US Patent 4,222,993. 16 Sep 1980. Filed date 28 Nov 1977. vp.

Gas contaminated with at least one noxious component, such as SO_2, HF or NOx, is scrubbed with a clear, calcium-containing,

initially-basic washing liquid which also comprises the anion of a strong inorganic acid, that of a polybasic carboxylic acid and, optionally, that of a monobasic carboxylic acid. Apparatus is provided for scrubbing the gas, oxidizing produced calcium bisulfite to calcium sulfate, separating out and removing solids, and recirculating clarified liquid for scrubbing contaminated gas.

10866 **Method for removing particulate matter from a gas stream and a method for producing a product using the removed particulate matter.** Schuff, R.W. (to Newbery Energy Corp). US Patent 4,220,478. 2 Sep 1980. Filed date 4 Dec 1978. vp.

A method is described for removing particulate matter from a gas stream by injecting charged particles into the gas stream to form a large charged surface area to induce charges on the entrained particulate matter. The injected material may be an adsorbent or an absorbent and may be reactive with the gases in the gas stream. The charged particles contained in the gas stream together with the injected particles are passed through a porous moving bed of media such as silica rock; as a result of the electrical charge as well as inertial impact forces on the respective particles, the particles become attached to the media which is continuously changed after it has captured the fine particulate matter. The media, together with attached sorbent additive and particulate matter, may then be incorporated into a product the manufacture of which generated the particulate matter.

10867 **Filter house and method for simultaneously removing NOx and particulate matter from a gas stream.** Pirsh, E.A. (to Babcock & Wilcox Co The). US Patent 4,220,633. 2 Sep 1980. Filed date 30 Apr 1979. vp.

A filter house (12) employing a selective catalytic reduction process for removing NOx emissions from a flue gas stream while simultaneously filtering out and collecting entrained particulate matter from the stream is described. Accordingly, the filter house (12) includes flue gas inlet and outlet passages (18, 30) and a plurality of porous filter bags. The bags are treated with a suitable catalyst to facilitate the selective catalytic reduction process.

10868 **Process for removal of sulfur dioxide from gases.** Gorin, E. (to Conoco Inc). US Patent T 998,010. 2 Sep 1980. Filed date 19 Nov 1979. vp.

An improvement is provided in the regeneration system of agueous regenerative processes for the removal of SO_2 from SO_2-containing gas streams which have a scrubbing system containing (1) a scrubbing zone through which a recirculating stream of sodium, potassium or ammonium thiosulfate solution continuously passes as a vehicle for the SO_2 absorbent-sodium, potassium, or ammonium carbonate-under conditions favorable to the formation of sulfite by the reaction of carbonate and SO_2 and (2) a thiosulfate generation zone in which the sulfite is converted by sulfide to thiosulfate. The improvement comprises converting in a regenerating system, the net make of thiosulfate to sulfide and carbonate by converting one portion of the thiosulfate to formate and the reacting the other portion with said formate.

10869 **Reduction of nitrogen oxides with catalytic acid resistant aluminosilicate molecular sieves and ammonia.** Pence, D.T.; Thomas, T.R. (to Dept. of Energy). US Patent 4,220,632. 2 Sep 1980. Filed date 10 Sep 1974. vp.

PAT-APPL 504,793.

Noxious nitrogen oxides in a waste gas stream such as the stack gas from a fossil-fuel-fired power generation plant or other industrial plant off-gas stream is catalytically reduced to elemental nitrogen and/or innocuous nitrogen oxides employing ammonia as reductant in the presence of a zeolite catalyst in the hydrogen or sodium form having pore openings of about 3 to 10 A.

10870 **Removal of gaseous alkali metal compounds from hot flue gas by particulate sorbents.** Lee, S.H.D.; Johnson, I. (Argonne Natl Lab, Ill). *American Society of Mechanical Engineers, [Paper]* ; No. 79-GT-154, 9(1979).

Six commercially available materials have been tested as granular sorbents to be used in granular-bed filters for the removal of gaseous alkali metal compounds from the hot (1073 to 1153 K) flue gas of pressurized fluidized-bed combustors (PFBC) for proposed combined-cycle power generation. Tests were performed using a simulated dry flue gas of PFBC in a laboratory-scale, fixed-bed combustor. Diatomaceous earth and activated bauxite were found to be the two most promising sorbents. The experimental results of screening tests are presented, along with the effects of temperature and superficial velocity and space velocity of the flue gas on the sorption performance for the two sorbents. Possible sorption mechanisms, applications of the sorbents and preliminary cost evaluations are discussed. 24 refs.

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REFER ALSO TO CITATION(S) 11064, 11065, 11066, 11070, 11072, 11073, 11075, 11076, 11078, 11080

10871 **(DOE/ET/29355—T1) Performance of a technical and economical feasibility study of an HVDC compressed gas insulated transmission line. Third quarterly progress report, April 1-June 30, 1980.** La Barge, R.L. (Aluminum Co. of America, Alcoa Center, PA. Alcoa Technical Center). 1980. Contract AC01-79ET29355. 157p. NTIS, PC A08/MF A01.

HVDC commissioning procedures have been successfully demonstrated with model cables. Particles of all types and in large numbers never found in a practical cable are placed in the middle of the model cable at the beginning but are trapped at the end of the commissioning procedure. The concepts of protecting the insulators have been successfully realized. Small particles are confined in the lower half of the cable and bounced into traps in the bulge. Large particles invading the top half of the cable are captured hovering around the ends and along the lower edge of the expansion-joint shield. None of the particles can contaminate the insulators. The simulation of the particle path was done with a microcomputer. The very simple simulation model predicts the effect of the enclosure profile and agrees with test observations. Both test observations and the simulations lead to the expectation that a successful HVDC commissioning procedure can be applied to the total length of an installed cable. Overvoltages within the cable due to lightning surges were analyzed. The most severe switching overvoltages were analyzed previously. A 1300 kV BIL and a 1050 kV BSIL are independently shown to be feasible. Lower BIL and BSIL could be feasible if the improvement of arrester technology is projected for longer term and/or if more elaborate protection schemes are introduced. Thermal expansion of the insulator was shown to be compatible with the metal inserts. As-cast conductors can be used to achieve equal, if not better, utilization of the gas dielectric strength with respect to lightning impulse. Other types of voltage are still to be assessed.

10872 **(DOE/ET/29355—T4) Performance of a technical and economical feasibility study of an HVDC compressed gas insulated transmission line.** LaBarge, R.L. (Aluminum Co. of America, Alcoa Center, PA. Alcoa Technical Center). 1 Apr 1980. Contract AC01-79ET29355. 106p. NTIS, PC A06/MF A01.

Progress in evaluating the technical feasibility of gas-insulated cables and circuit breakers for HVDC systems (600 kV) is reported. Investigations with a model cable resulted in cautious optimism that it will be possible to commission the total length of an installed cable with HVDC. The major problem is to prevent the insulators from being contaminated by residual particles. The model cable was used to test a new design principle that particles moving towards the insulator can be directed toward a shield on the conductor adjacent to the insulator and be confined at the end edges of the shield. Then they can be trapped and retained inside a particle trap at the bottom of each bulge. Results showed that all metal particles can be moved out of a 2 ft length of enclosure in minutes, and that no particles were seen on or in the vicinity of the insulator. Specific plans for accelerating this project are outlined. (LCL)

10873 **(DOE/ET/29355—T11) Performance of a technical and economical feasibility study of an HVDC compressed gas insulated transmission line.** LaBarge, R.L. (Aluminum Co. of America, Alcoa Center, PA. Alcoa Technical Center). 15 Dec 1980. Contract AC01-79ET29355. 33p. NTIS, PC A03/MF A01.

Progress in evaluating the technical feasibility of SF_6-insulated cables and circuit breakers for HVDC systems is reported. During this reporting period a new test setup was completed. An assembly jig was designed and fabricated. Model cable up to 20-ft length can be assembled complete outside the test tank. Components to extend the test tank to accommodate a 20-ft model cable have been obtained. A report was drafted on the effect of material selection as well as processing into insulators on the long-term dielectric performance of the insulator. The vertical leaf expansion joint design was improved by replacing the Alcuplate copper-to-aluminum transition piece with nickel plating on the aluminum parts. The joint was fatigue tested with condition which simulate almost 2 1/2 cycles of temperature excursions each day for the 40 year design life of the line. Electrical tests of the joint are in progress.

10874 (DOE/RG—0054) Analysis of electrical power system disturbance and outage in Garland and Greenville, Texas, June 26, 1980. (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). Jan 1981. 54p. NTIS, PC A04/MF A01.

On June 26, 1980, the municipal electric systems of Garland and Greenville, Texas, both experienced total system outages which lasted from 2:01 p.m. until 10:15 p.m. that evening. In order to understand more fully the causes of this disturbance, a technical analysis was initiated to consider: the status of each of the involved utility systems prior to initiation of the disturbance; the sequence of events which occurred between the initial event precipitating the interruption and the total system outages; the restorative procedures implemented by the involved systems; and any procedural changes or facility modifications that should be considered by the involved systems. Each of these items is discussed, and recommendations are made for developing an emergency operation plan, for isolating the two distribution systems when a significant system frequency excursion occurs, and for developing power pool operating criteria and contingency plans. (LCL)

10875 (EPRI-EL—80-8-LD) Workshop of arc by-products in gas-insulated equipment. Final report. Tahiliani, V.H.; Vouros, P. (Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1980. 58p. NTIS, PC A04/MF A01.

A two-day workshop, organized by the Electric Power Research Institute, and entitled Arc By-products in Gas-Insulated Equipment, was held at the Hyatt Regency Hotel in Chicago on June 4 and 5, 1980. Organization of the workshop was largely prompted by the recently concluded project, which was jointly undertaken by Gould-Brown Boveri of Greensburg, PA, and Doble Engineering of Watertown, MA. This project was sponsored by EPRI and aimed at developing a chemical data base on the generation of arc by-products in GIS-type equipment. The first day consisted of a presentation of scientific papers by researchers involved in the investigation of various aspects of arc-induced decomposition of SF_6, such as identification and quantitation of by-products, mechanisms of their formation and analytical methods used for their determination. The objective of this first day of the workshop was to provide an opportunity for peer discussion and the sharing of research ideas and problems. The second day of the workshop was primarily a report of the progress of the Gould-Brown Boveri/Doble Engineering project to the users of SF_6-insulated equipment. The objective of the second day of the workshop was to make the users aware of the type of arc by-products encountered in SF_6-insulated equipment, and to solicit their input with regard to the direction of any future work, based on their own experiences. In addition to most of the participants in the first day of the workshop, the second day was also attended by representatives of several electric utility companies. A complete list of the participants in each of the days of the workshop is given in Appendices I and II, respectively.

10876 (EPRI-EL—1627) Study of distribution system surge and harmonic characteristics. Final report. Owen, R.E.; Vivirito, J.R. (McGraw-Edison Co., Canonsburg, PA (USA); United Technologies Corp., South Windsor, CT (USA). Power Systems Div.; Systems Control, Inc., Palo Alto, CA (USA)). Nov 1980. 269p. NTIS, PC A12/MF A01.

The characteristics of electrical noise and power harmonics from power converters and other harmonic sources, as well as the effects of such noise and harmonics on distribution system equipment and operation are described. Power system surges and their effects on converter equipment are also described. Field tests were conducted on two different distribution systems. Measurements were made of harmonic voltage and current magnitudes, capacitor-switching transients, and impulsive electromagnetic noise in the frequency range of 3 kHz to 300 kHz. Test methodology and instrumentation are described, and the measured results are presented. The implications of this high-frequency noise on power line communication systems are discussed. A computer program was developed to aid in analyzing distribution system response to harmonic sources on the system. Simulations performed for the two distribution systems tested are described, and comparisons between simulation results and measured harmonic magnitudes are presented. The project also addressed methods of controlling harmonics on distribution systems. The different methods for harmonic control, principally the filtering and/or phase cancellation of harmonics, are described.

10877 (EPRI-EL—1646) Study of arc by-products in gas-insulated equipment. Final report. Baker, A.; Dethlefsen, R.; Dodds, J.; Oswalt, N.; Vouros, P. (Gould-Brown Boveri, Greensburg, PA (USA)). Dec 1980. 111p. NTIS, PC A06/MF A01.

The project objective was to develop a chemical data base for sulfur hexafluoride, SF_6 decomposition products as generated by electrical discharges within gas-insulated equipment to serve as a basis for unified handling procedures of faulted SF_6 equipment and disposal of the arc products. An analysis capability was to be developed that could be used by utilities for incipient and actual fault analysis on SF_6 insulated power equipment. Arced SF_6 gas and solid samples were generated in test devices which simulate SF_6 circuit breakers or SF_6 insulated bus. Actual production hardware and procedures were used for assembly of the test devices. Fault arc currents ranged between 15 kA and 50 kA. Arced SF_6 samples were obtained and shipped in stainless steel cylinders. Gaseous arc products were analyzed with a combination of gas chromatography-mass spectrometry. The attained sensitivity is 100 ppM. The major SF_6 arc products are SOF_2 and CF_4. The amount increases with the arc energy. SOF_2 can effectively be removed by absorber-scrubbers containing soda-lime, activated alumina and molecular sieves. The solid arc products consisted of metal fluorides (AlF_3 and $CuF_2.2\ H_2O$). Airborne dust, collected upon opening of the faulted test section had a size of about 10 micron.

10878 (EPRI-EL—1647) Development of a new type of nonlinear resistance valve block for surge arresters. Final report. Sokoly, T.O.; Seitz, M.A.; Guertin, J.P.; Schumacher, P.P.; Potter, M.E. (McGraw-Edison Co., Franksville, WI (USA)). Dec 1980. 136p. NTIS, PC A07/MF A01.

Present day surge arresters based on silicon carbide material have approached their technological performance limits because of the relatively low degree of nonlinearity in their V-I characteristics. Series gaps were introduced to compensate for this, but the gaps complicate arrester assembly and raise costs, while reducing both protection and reliability. Since 1970, electrical equipment manufacturers have been improving the quality of arresters with material based on zinc oxide. This ceramic material has a very high degree of nonlinearity in its V-I characteristic. The research project conducted here investigated how chemical composition and processing variables affected the electrical and physical characteristics of these metal oxide varistors. Various chemical compositions were studied. Bismuth oxide, antimony oxide, cobalt oxide, manganese oxide, chromium oxide, nickel oxide, and aluminum oxide in a zinc-oxide based varistor were evaluated. The effect of these materials on the varistors' leakage current, discharge voltage, and energy handling capability was evaluated. Mixing procedures and sintering programs were then established for the processing of these varistors. Since the elimination of series gaps would require the metal oxide arrester to be continuously subjected to operating voltage, the work sought to determine the mechanisms and controlling variables affecting a long-term deterioration of these varistors. Based on the electrical modes of conduction, an equivalent circuit model was constructed for the devices. Methods of encapsulating a stack of varistor blocks into an epoxy housing were examined and a potential application for the gapless arrester was demonstrated.

10879 (EPRI-EL—1648(Vol.1)) Area Control Simulator Program. Volume 1. Technical manual. Final report. Smith, L.M.; Spare, J.H. (Philadelphia Electric Co., PA (USA). Research and Testing Div.). Dec 1980. 59p. NTIS, PC A04/MF A01.

The purpose of this study was to develop an engineering-grade digital computer simulation program for a single-area power system and to hold a workshop at which this simulation package would be presented. This and the companion volumes present our philosophy of modeling a power system and demonstrate the simulation capabilities of the area control simulator. The results of this research study have been the development of the area control simulator computer program; the conduct of the Area Control Simulator Workshop held May 1-3, 1979; and the creation of the Technical Manual (Volume 1), the Programming Manual (Volume 2), and the Program Listing (Volume 3). The above-mentioned three volumes, in addition to a fourth volume, Multiarea Models, serve as a final report for this project. This volume is presented to provide the area control simulator user with an understanding of our philosophy of modeling and of the system dynamics that are being simulated. Programming questions regarding the area control simulator computer program should be referred to the Programming Manual and the Program Listing.

10880 (EPRI-EL—1648(Vol.2)) Area Control Simulator Program. Volume 2. Programming manual. Final report. Smith, L.M.; Spare, J.H. (Philadelphia Electric Co., PA (USA). Research and Testing Div.). Dec 1980. 57p. NTIS, PC A04/MF A01.

The purpose of this EPRI-sponsored study was to develop a digital computer simulation program for a single-area power system and to hold a workshop at which this simulation package would be presented. This and the companion volumes present our philosophy of modeling a power system and demonstrate the simulation capabilities of the Area Control Simulator. The results of this research study have been the development of the Area Control Simulator, the Area Control Simulator Workshop held May 1-3, 1979; and the creation of the Technical Manual (Volume 1), the Programming Manual (Volume 2), and the Program Listing (Volume 3). The above-mentioned three volumes in addition to a fourth volume covering a multiarea model development serve as a final report for this project. This volume, the Programming Manual, is presented to provide the Area Control Simulator user with an understanding of the overall computer program structure, its interconnections and use. In addition, the details of assembling a case study are highlighted and the use of input/output features are addressed. Technical questions regarding the system dynamics should be referred to Volume 1, the Technical Manual.

10881 (EPRI-EL—1648(Vol.3)) Area Control Simulator Program. Volume 3. Program listing. Final report. Smith, L.M.; Spare, J.H. (Philadelphia Electric Co., PA (USA). Research and Testing Div.). Dec 1980. 98p. NTIS, PC A05/MF A01.

The purpose of this EPRI-sponsored study was to develop a digital computer simulation program for a single-area power system, and to hold a Workshop at which this simulation package would be presented. This and the companion volumes present our philosophy of modeling a power system and demonstrate the simulation capabilities of the Area Control Simulator. The results of this research study have been the development of the Area Control Simulator, the Area Control Simulator Workshop held May 1-3, 1979; and the creation of the Technical Manual (Volume 1), the Programming Manual (Volume 2), and the Program Listing (Volume 3). The above-mentioned three volumes in addition to a fourth volume covering a multiarea model development serve as a final report for this project.

10882 (EPRI-EL—1648(Vol.4)) Area Control Simulator Program. Volume 4. Multiarea models. Final report. Smith, L.M.; Spare, J.H. (Philadelphia Electric Co., PA (USA). Research and Testing Div.). Dec 1980. 28p. NTIS, PC A03/MF A01.

The purpose of this EPRI-sponsored research project was to develop a digital computer simulation program for a single-area power system and associated user's manuals. The single-area model, the Area Control Simulator, was developed and presented at the Area Control Simulator Workshop held at EPRI in Palo Alto, CA on May 1-3, 1979. The details and description of this model are covered in a Technical Manual, Volume 1, a Programming Manual, Volume 2, and a Program Listing, Volume 3 of the final report The remaining tasks associated with this program cover the development of a multiarea model and its delivery to Control Data Corporation for the companion project RP 1048-1.

10883 VAR control: leading and lagging power factor. Boyle, J.R. Washington, DC; Library, American Public Power Association (1980). 20p. (CONF-800264—9).

From 24. American Public Power Association annual engineering and operations workshop; Phoenix, AZ, USA (25 Feb 1980).

Using the examples of power system failures in Jacksonville, Florida, New York City, and France which were the result of either a deficiency of installed VAR generation sources or an excess of VAR's after the affected system had been isolated, the problem of VAR control in general is discussed and some insight is provided as to how situations can occur to cause system instability because of deficient or excess VARS. (LCL)

21 NUCLEAR POWER PLANTS

10884 (DOE/NE—0030/4(80)) US central station nuclear electric generating units: significant milestones. Status as of October 1, 1980. (Department of Energy, Washington, DC (USA). Office of Nuclear Reactor Programs). Dec 1980. 43p. NTIS, PC A03/MF A01.

This document comprises lists of the nuclear power units according to state, region, and utility. A tabulation of status, schedules, and orders is also included. (DLC)

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 10933, 10948

10885 (DOE/ET/34002—1) Development and demonstration of surveillance and diagnostics of rotating machinery for reducing radiation exposure to nuclear power plant personnel. Annual technical progress report, 1 January 1979-30 September 1980. Piety, K.R. (Technology for Energy Corp., Knoxville, TN (USA)). Sep 1980. Contract AC02-79ET34002. 92p. NTIS, PC A05/MF A01.

A comprehensive monitoring program for rotating machinery has been initiated at the Grand Gulf Nuclear Station. This program is designed to reduce radiation exposure to personnel resulting from inspection, maintenance, and repair of rotating equipment in a commercial power plant. A computer-based monitoring system is being implemented that utilizes both process and vibration instrumentation to monitor the operational performance of fourteen major pumps, two drive-turbines, twelve motors, three air compressors, the high and low pressure turbines, and the generator-exciter. The monitoring system rapidly scans gross parameter values and warns the operator if alarm limits are exceeded. Once per day the system recalls hourly, gross parameter values and compares these against more sensitive alert limits and performs spectral analysis on all vibration sensors. This provides an early warning of incipient failures. The hourly gross parameters and selected spectral features are also preserved to provide a historical base for diagnostic functions.

10886 (EPRI-NP—1689-SR) Impact of operational experience on research and development. Loewenstein, W.B.; Adamantiades, A.G. (Electric Power Research Inst., Palo Alto, CA (USA)). Jan 1981. 23p. NTIS, PC A02/MF A01.

The gradual accumulation of operating experience data from nuclear plants is having a perceptible impact on the direction of research and development. Four areas where this influence is best manifested are identified: increased awareness of systems interaction, the importance of operational data for code qualification, a sharper focus of separate effects; and the importance of well-de-

fined scaled experiments. Illustrations from EPRI-sponsored and EPRI-conducted projects are presented.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

10887 **(COO—34010-1) Evaluation and demonstration of methods for improved fuel utilization. First semi-annual progress report, September 1979-March 1980.** Decher, U. (Combustion Engineering, Inc., Windsor, CT (USA); Omaha Public Power District, NE (USA)). 25 Jun 1980. Contract AC02-79ET34010. 44p. (CEND—382). NTIS, PC A03/MF A01.

Purpose of this program is to demonstrate two techniques for improving fuel utilization in current PWRs: more efficient fuel management and high burnup. These demonstrations are being performed in the Fort Calhoun reactor located near Omaha, Nebraska. More efficient fuel management will be achieved through the implementation of a low leakage concept called SAVFUEL (Shimmed And Very flexible Uranium Element Loading), which is expected to reduce uranium requirements by 2 to 4%. The burnup will be increased sufficiently to reduce uranium requirements by 5 to 15%.

10888 **(DOE/ET/34010—1) Evaluation and demonstration of methods for improved fuel utilization. First semi-annual progress report, September 1979-March 1980.** Decher, U. (Combustion Engineering, Inc., Windsor, CT (USA). Power Systems Group; Omaha Public Power District, NE (USA)). 25 Jun 1980. Contract AC02-79ET34010. 43p. NTIS, PC A43/MF A01.

Demonstrations of improved fuel management and burnup are being performed in the Fort Calhoun reactor. More efficient fuel management will be achieved through the implementation of a low leakage concept called SAVFUEL (Shimmed And Very Flexible Uranium Element Loading), which is expected to reduce uranium requirements by 2 to 4%. The burnup will be increased sufficiently to reduce uranium requirements by 5 to 15%. Four fuel assemblies scheduled to demonstrate the SAVFUEL duty cycle and loaded into the core in December 1978 were inspected visually prior to their second exposure cycle. In addition, seventeen fuel assemblies were inspected after their fourth exposure cycle having achieved assembly average burnup up to 36 GWD/T. One assembly has been reinserted into Cycle 6 for a fifth exposure cycle. The preliminary results of all visual fuel inspections which appear to show excellent fuel rod performance are presented in this report. This report also contains the results of a licensing activity which was performed to allow insertion of a highly burned assembly into the reactor for a fifth irradiation cycle.

10889 **(EPRI-NP—1607) Method of reducing carry-over and reducing pressure drop through steam separators.** Carson, W.R.; Williams, H.K. (Combustion Engineering, Inc., Chattanooga, TN (USA)). Nov 1980. 337p. NTIS, PC A15/MF A01.

Steam separation equipment affects both the operation and performance of a PWR steam generator in terms of pressure drop, carryover, and carryunder. Carryover, the moisture entrained in the exiting steam flow, results in decreased plant efficiency and may lead to premature turbine blade failure. Carryunder, steam entrained in the circulating water flow, has a potential for decreasing the circulating water flow rate, and it may adversely affect the operating performance of the steam generator. To help prevent chemical hideout in the tube bundle, a high circulating water flow (i.e., circulation ratio) should be developed. The differential pressure for this circulating flow cannot be maintained if excessive carryunder exists which cannot be condensed by the addition of subcooled feedwater in the steam generator downcomer. Recognizing these principles of operation, this project determined the benefits which might be recognized from improved primary steam generator performance, identified three separator designs worthy of future development, and developed a recommended test program for verification testing of separator design improvement. In general, however, the studies revealed that the circulation ratio cannot be significantly improved by decreasing the primary separator pressure drop. Backfit of presently used primary separators into field steam generators to obtain improved performance was evaluated. An extensive literature search in the area of separator design was also developed.

10890 **(EPRI-NP—1676-SR) Review of natural circulation loops in pressurized water reactors and other systems.** Zvirin, Y. (Electric Power Research Inst., Palo Alto, CA (USA)). Jan 1981. 70p. NTIS, PC A04/MF A01.

A survey is presented on the theoretical and experimental work on single-phase natural circulation loops (thermosyphons). It includes available modeling methods (analytical and numerical) to describe steady state flows, transients and stability characteristics of the various loops. These range from simple geometry systems through small-scale (laboratory) loops to full-scale systems - nuclear reactor plants and solar water heaters. An attempt is made to compare some of the analytical models and to present the results by using generalized parameters. The available data is given and the comparison with the theoretical results is discussed.

10891 **(EPRI-NP—1678) Thermal-hydraulic analysis of the Combustion Engineering Series 67 steam generator. Final report.** Inch, W.W.R. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jan 1981. 183p. NTIS, PC A09/MF A01.

This report presents the results of a thermal-hydraulic analysis of the Combustion Engineering Series 67 recirculating-type steam generator using THIRST - a three-dimensional, steady state, incompressible, homogeneous, two-phase flow computer code. The analysis was done for operating conditions corresponding to 100%, 50%, and 20% of the nominal full power. The THIRST computer code methodology is discussed, and the assumptions, operating conditions and empirical correlations are given. Results are presented in the form of detailed printouts and computer-generated plots of quality, velocity and mass flux distributions. The printout data include calculated values of overall heat transfer, circulation ratio, primary inlet temperature, as well as velocity, quality, temperature, pressure and density fields.

2103 Power Reactors, Non-breeding, Graphite Moderated

10892 **(AD-A—085861) Numerical study of formation of thermal non uniformities in active packed beds. Final report.** Hill, M.; Buchlin, J. (Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium)). Jun 1978. 84p. NTIS, MF A01.

The purpose of this work was to mathematically model the heat transfer in an active bed heat exchanger and to develop an appropriate numerical scheme for the solution of the temperature field. As active packed beds are being considered for use in nuclear reactors, concern is generated as to whether regions of relatively high temperatures will develop. Such concern is the impetus behind the application of the program to two applications concerning heat transfer in packed beds assuming variable porosity of the Brosilow type and the existence of blockages. The results show that for the case of a packed bed with the porosity distribution the so-called hot spot occurs near the wall of the bed. Its magnitude and position were seen to be strongly affected by the assumed velocity profile and wall boundary conditions. In addition, as the proposed mathematical equations include axial conduction as opposed to a previously developed program which excluded axial conduction and as the results of the two programs approached one another as the Re increased, it is reasonable that the previous program (as it is based on parabolic, not elliptic equations as in the present case) could be implemented with little error expected due to the lack of axial conduction.

10893 **(ANL/MSD—80-8) Review of current practices and requirements for the inspection of prestressed concrete pressure vessels.** Reimann, K.J. (Argonne National Lab., IL (USA)). Dec 1980. Contract W-31-109-ENG-38. 12p. NTIS, PC A02/MF A01.

Code requirements for pre- and in-service inspection of prestressed concrete pressure vessels as utilized in gas-cooled reactors are reviewed and compared with practices and experiences during

construction, commissioning, and operation of such reactors. The pre-service inspection relies heavily on embedded instrumentation for measurements of stresses, temperatures, and displacements. The same instrumentation is later used for in-service surveillance, which additionally includes visual examination of exposed surfaces, monitoring of tendon conditions, and measurement of tendon loads. Improvement of present monitoring instrumentation and/or techniques, rather than development of new in-service inspection methods, is recommended.

10894 **(GA-A—16016) Response of a thermal barrier system to acoustic excitation in a gas turbine nuclear reactor.** Betts, W.S. Jr.; Blevins, R.D. (General Atomic Co., San Diego, CA (USA)). Nov 1980. Contract AT03-76SF70046. 11p. (CONF-810309—7). NTIS, PC A02/MF A01.

From ASME gas turbine conference; Houston, TX, USA (9 Mar 1981).

A gas turbine located within a High-Temperature Gas-Cooled Reactor (HTGR) induces high acoustic sound pressure levels into the primary coolant (helium). This acoustic loading induces high cycle fatigue stresses which may control the design of the thermal barrier system. This study examines the dynamic response of a thermal barrier configuration consisting of a fibrous insulation compressed against the reactor vessel by a coverplate which is held in position by a central attachment fixture. The results of dynamic vibration analyses indicate the effect of the plate size and curvature and the attachment size on the response of the thermal barrier.

10895 **(GA-A—16064) Postirradiation examination of capsule GF-4.** Kovacs, W.J.; Sedlak, B.J. (General Atomic Co., San Diego, CA (USA)). Oct 1980. Contract AT03-76ET35300. 147p. NTIS, PC A06/MF A01.

The GF-4 capsule test was irradiated in the SILOE reactor at Grenoble, France between April 8, 1975 and July 26, 1976. High-enriched uranium (HEU) UC_2 and weak acid resin (WAR) UC/sub x/O/sub y/ fissile and ThO_2 fertile particles were tested. Postirradiation examination of cured-in-place fuel rods showed no fuel rod/graphite element interaction. In addition, all rods exhibited adequate structural integrity. Irradiation-induced dimensional changes for rods containing all TRISO-coated fuel were consistent with model predictions; however, rods containing BISO-coated fuel exhibited greater volumetric contractions than predicted.

10896 **(GA-A—16127) HTGR Generic Technology Program. Semiannual report for the period ending September 30, 1980.** (General Atomic Co., San Diego, CA (USA)). Nov 1980. Contract AT03-76ET35300. 384p. NTIS, PC A17/MF A01.

This document reports the technical accomplishments on the HTGR Generic Technology Program at General Atomic during the second half of FY-80. It covers a period when the design direction of the National HTGR Program is in the process of an overall review. The HTGR Generic Technology Program activities have continued so as to provide the basic technology required for all HTGR applications. The activities include the need to develop an LEU fuel and the need to qualify materials and components for the higher temperatures of the gas turbines and process heat plants.

10897 **(GA-A—16224) US/FRG umbrella agreement for cooperation in GCR development: fuel, fission products and graphite subprogram. Quarterly status report, October 1, 1980-December 31, 1980.** Gulden, T.D. (General Atomic Co., San Diego, CA (USA)). Jan 1981. Contract AT03-76ET35300. 18p. NTIS, PC A02/MF A01.

Status of progress in each area of the subprogram is summarized, including meetings, cooperation, and work breakdown structure elements. No hard data is included. (DLC)

10898 **(GEFR-SP—230(SP)) High temperature gas reactor and energy pipeline system.** Daniels, E.; Blazek, C.; Allen, D.C.; Pflasterer, G.R. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.; Institute of Gas Technology, Chicago, IL (USA)). 19 Dec 1980. Contract AC03-80ET34034. 23p. (CONF-810209—1). NTIS, PC A02/MF A01.

From Interpipe conference; Houston, TX, USA (24 Feb 1981).

A study was made of the following aspects of the High Temperature Gas Reactor (HTGR) Closed Loop Chemical Energy Pipeline (CEP) concept: pipeline transmission and storage system design, pipeline and storage system cost, methane reformer interface, and system safety and environmental aspects. This paper focuses on the pipeline and storage system concepts. Pipeline size, compressor power, and storage facility requirements were developed for four different types of pipeline systems to obtain system cost estimates. Each pipeline system includes a synthesis-gas pipeline from the reformer to the methanator, a methane-rich gas pipeline from the methanator to the reformer, a water return line from the methanator to the reformer, and storage for the synthesis gas, methane-rich gas and water.

10899 **(ORNL/TM—7542) Stability analysis of the high temperature thermal pebble bed nuclear reactor concept.** Vondy, D.R. (Oak Ridge National Lab., TN (USA)). Feb 1981. Contract W-7405-ENG-26. 73p. NTIS, PC A04/MF A01.

A study was made of the stability of the high temperature gas-cooled pebble bed core against xenon-driven oscillation. This generic study indicated that a core as large as 3000 MW(t) could be stable. Several aspects present a challenge to analysis including the void space above the pebble bed, the effects of possible control rod configurations, and the temperature feedback contribution. Special methods of analysis were developed in this effort. Of considerable utility was the scheme of including an azimuthal buckling loss term in the neturon balance equations admitting direct solution of the first azimuthal harmonic for a core having azimuthal symmetry. This technique allows the linear stability analysis to be done solving two-dimensional (RZ) problems instead of three-dimensional problems. A scheme for removing the fundamental source contribution was also implemented to allow direct iteration toward the dominant harmonic solution, treating up to three dimensions with diffusion theory.

10900 **(ORNL/TM—7571) Characterization of SiC coatings on HTGR fuel particles. Final report.** Lauf, R.J.; Braski, D.N. (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-26. 33p. NTIS, PC A03/MF A01.

Fuel particles for the HTGR contain a layer of pyrolytic silicon carbide to act as a pressure vessel and fission product barrier. The SiC is deposited by thermal decomposition of methyltrichlorosilane (CH_3SiCl_3 or MTS) in an excess of hydrogen. Coatings deposited at temperatures from 1500 to 1700°C and coating rates from 0.4 to 1.2 μm/min have been studied by transmission electron microscopy, small-angle x-ray scattering, x-ray diffraction, optical microscopy, density measurements, scanning electron microscopy, and microhardness measurements. Transmission electron microscopy has the necessary resolution to provide crystallographic information on small coating defects. Major defects were voids, stacking faults, and dislocations. Small-angle x-ray scattering was used to measure the void size distribution; voids were generally from 20 to 80 nm in diameter. X-ray diffraction indicates that SiC coatings are predominantly cubic β-SiC. However, the high stacking fault density in some coatings can give rise to both x-ray and electron diffraction effects. In some small areas the faulted structure resembles one or more polytypes of α-SiC. The evidence indicates though that this is a consequence of rapid growth and not a two-phase $\alpha + \beta$ mixture in the thermodynamic sense. Reflected-light microscopy can be used quantitatively to measure average grain size and shape but cannot resolve most coating defects. Density measurement can be used to differentiate between coatings that exhibit extremes in performance but cannot be used to detect small variations in quality. Scanning electron microscopy shows that deposition variables affect coating surface morphology, but these features are difficult to quantify and do not bear a simple relationship to internal coating defects. Microhardness was a very insensitive indicator of coating quality. 15 figures.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 10931, 10938, 10939, 10952, 10955

10901 (DOE/ET/37240—78TR) Comparison between the SIMPLE and ENERGY mixing models. Burns, K.J.; Todreas, N.E. (Massachusetts Inst. of Tech., Cambridge (USA)). Jul 1980. Contract AS02-76ET37240. 75p. NTIS, PC A04/MF A01.

The SIMPLE and ENERGY mixing models were compared in order to investigate the limitations of SIMPLE's analytically formulated mixing parameter, relative to the experimentally calibrated ENERGY mixing parameters. For interior subchannels, it was shown that when the SIMPLE and ENERGY parameters are reduced to a common form, there is good agreement between the two models for a typical fuel geometry. However, large discrepancies exist for typical blanket (lower P/D) geometries. Furthermore, the discrepancies between the mixing parameters result in significant differences in terms of the temperature profiles generated by the ENERGY code utilizing these mixing parameters as input. For edge subchannels, the assumptions made in the development of the SIMPLE model were extended to the rectangular edge subchannel geometry used in ENERGY. The resulting effective eddy diffusivities (used by the ENERGY code) associated with the SIMPLE model are again closest to those of the ENERGY model for the fuel assembly geometry. Finally, the SIMPLE model's neglect of a net swirl effect in the edge region is most limiting for assemblies exhibiting relatively large radial power skews.

10902 (DOE/TIC—3333(Suppl.6)(Vol.1)) Liquid Metal Fast Breeder Reactors: a bibliography. Raleigh, H.D. (ed.). (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Nov 1980. 811p. NTIS, PC A99/MF A01.

This bibliogralphy includes 5465 selected citations on LMFBR development. The citations were compiled from the DOE Energy Data Base covering the period January 1978 (EDB File No. 78R1087) through August 1980 (EDB File No. 80C79142). The references are to reports from the Department of Energy and its contractors, reports from other government or private organizations, and journal articles, books, conference papers, and monographs from US originators. Report citations are arranged alphanumerically by report number; nonreport literature citations are arranged chronologically. Corporate, Personal Author, Subject, and Report Number Indexes are provided in Volume 2.

10903 (DOE/TIC—3333(Suppl.6)(Vol.2)) Liquid Metal Fast Breeder Reactors: a bibliography. Raleigh, H.D. (ed.). (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Nov 1980. 375p. NTIS, PC A16/MF A01.

This bibliography includes 5465 selected citations on LMFBR development. The citations were compiled from the DOE Energy Data Base covering the period January 1978 (EDB File No. 78R1087) through August 1980 (EDB File No. 80C79142). The references are to reports from the Department of Energy and its contractors, reports from other government or private organizations, and journal articles, books, conference papers, and monographs from US originators. Report citations are arranged alphanumerically by report number; nonreport literature citations are arranged chronologically. Corporate, Personal Author, Subject, and Report Number Indexes are provided in Volume 2.

10904 (EPRI-NP—1616(Vol.1)) Conceptual design of a 1000-MW(e) heterogeneous oxide LMFBR. Final report. Barthold, W.P.; Tzanos, C.P. (Science Applications, Inc., Oak Brook, IL (USA)). Nov 1980. 246p. NTIS, PC A12/MF A01.

A numerical core/blanket design is presented for a large, 1000 MW(e) LMFBR that has a much lower sodium void coefficient of reactivity than would be the case for a core assembly made up entirely of fuel subassemblies with an appropriate number of control rods. Blanket subassemblies are placed among the fuel subassemblies to form a heterogeneous core/blanket assembly that would have low energetics in case of a hypothetical core disruptive accident (HCDA) but still retains good thermohydraulic performance, good breeding gain, and a reasonable fuel cycle.

10905 (EPRI-NP—1616(Vol.2)) Conceptual design of a 1000-MW(e) heterogeneous oxide LMFBR. Volume 2. Appendixes. Final report. Barthold, W.P.; Tzanos, C.P. (Science Applications, Inc., Oak Brook, IL (USA)). Nov 1980. 384p. NTIS, PC A17/MF A01.

A numerical core/blanket design is presented for a large, 1000-MW(e) LMFBR that has a much lower sodium void coefficient of reactivity than would be the case for a core assembly made up entirely of fuel subassemblies with an appropriate number of control rods. This volume contains appendices on: optimization of control rod position, axial blanket, radial blanket residence time, and enrichment zoning; cycle length sensitivity analysis; RZ vs HEX-Z sodium void reactivity; thermal-hydraulic analysis of 0.26-in fuel pin dia; fuel life analysis; pin diameter selection; fuel management; natural B_4C control rod; flow split analysis; blanket power/flow ratio and sodium boiling incoherency; and vented duct design. (DLC)

10906 (EPRI-NP—1657) Fast Breeder Blanket Facility. Interim report, January 1981. Clikeman, F.M. (ed.). (Purdue Univ., Lafayette, IN (USA). School of Nuclear Engineering). Jan 1981. 78p. NTIS, PC A05/MF A01.

The Fast Breeder Blanket Facility (FBBF) located at Purdue University is a subcritical facility designed to investigate the neutron and gamma-ray physics of the blankets of fast breeder reactors (FBR). The facility was designed to mock-up, using UO_2 fuel rods, the blanket regions of FBR's. The facility, using a cylindrical geometry and an isotopic neutron source, drives the experimental blanket region with a neutron flux that has an energy and spatial dependence similar to a 1000 ME(e) FBR. Measurements of the neutron reaction rates, both capture and fission, neutron energy spectra, and gamma-ray absorption rates as a function of position in the blankets can be measured and then compared with calculated values. This report contains a summary of the philosophy and design considerations in the facility. Since the facility was to be built and operated at a university, special safety considerations had to be factored into the design. The report also contains a detailed description of the facility together with a summary of criticality calculations that were made to insure the safety of the facility under both normal and accidental flooding conditions. A summary of the measurements of k/sub eff/ and the shielding, as required by part of the license conditions are also presented. Finally, samples of some of the preliminary experimental measurements are presented.

10907 (LA—8623-PR) Examination of fast reactor fuels and FBR analytical quality assurance standards and methods. Progress report, July 1-September 30, 1980. Maraman, W.J. (comp.). (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 16p. NTIS, PC A02/MF A01.

Information is presented concerning equipment development; analytical chemistry; requests from DRRT; and quality assurance.

10908 (ORNL/TM—7288) Temperature instrumentation and telemetry for thermal striping test specimens. Carroll, R.M.; Kerlin, T.W.; Rochelle, J.M.; Shepard, R.L. (Oak Ridge National Lab., TN (USA)). Mar 1981. Contract W-7405-ENG-26. 26p. NTIS, PC A03/MF A01.

A 356-mm-long section of 3-1/2 in., schedule 80, type 304 stainless steel pipe was instrumented with four, type K insulated junction thermocouples embedded at precise locations in the inner wall of the pipe. The sheath diameter of the thermocouples was 0.81 mm and their response times were ~ 22 ms. After the thermocouples were embedded, response times were measured by plunging the pipe section into a bath of liquid metal. The response times varied from 0.21 to 1.27 s, depending on the embedded depth. A new analytical method was developed to calculate the response time for the test condition, wherein the bath simultaneously heated the pipe segment but became cooled by the insertion of the pipe segment. A short-range radio transmitter-receiver, which added 27 ms to the response time, was installed to transmit the thermocouple signals. The new computer analysis technique and the telemetry response time were verified by measuring the thermocouple response

time with two different methods while the pipe segment was plunged into a large circulating water bath.

10909 **(STI/PUB—529(Vol.1)) Fast reactor physics, 1979. Proceedings Series.** (International Atomic Energy Agency, Vienna (Austria)). Jul 1980. 622p. (In several languages). (CONF-790933—(Vol.1)). IAEA.

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

Thirty-one papers are presented in this volume under three section headings: physics of conventional cores of large fast power reactors, physics of operating fast reactors, and physics of burnup in fast reactors. Separate abstracts were prepared for 29 of the papers; the remaining two were previously abstracted. (DLC)

10910 **(WAPD-TM—1422) Uranium-233 purification and conversion to stabilized ceramic grade urania for LWBR fuel fabrication (LWBR Development Program).** Lloyd, R. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Oct 1980. Contract AC11-76PN00014. 51p. NTIS, PC A04/MF A01.

High purity ceramic grade urania ($^{233}UO_2$) used in manufacturing the fuel for the Light Water Breeder Reactor (LWBR) core was made from uranium-233 that was obtained by irradiating thoria under special conditions to result in not more than 10 ppM of uranium-232 in the recovered uranium-233 product. A developmental study established the operating parameters of the conversion process for transforming the uranium-233 into urania powder with the appropriate chemical and physical attributes for use in fabricating the LWBR core fuel. This developmental study included the following: (a) design of an ion exchange purification process for removing the gamma-emitting alpha-decay daughters of uranium-232, to reduce the gamma-radiation field of the uranium-233 during LWBR fuel manufacture; (b) definition of the parameters for precipitating the uranium-233 as ammonium uranate (ADU) and for reducing the ADU with hydrogen to yield a urania conversion product of the proper particle size, surface area and sinterability for use in manufacturing the LWBR fuel; (c) establishment of parameters and design of equipment for stabilizing the urania conversion product to prevent it from undergoing excessive oxidation on exposure to the air during LWBR fuel manufacturing operations; and (d) development of a procedure and a facility to reprocess the unirradiated thoria-urania fuel scrap from the LWBR core manufacturing operations to recover the uranium-233 and convert it into high purity ceramic grade urania for LWBR core fabrication.

10911 **Vapor source distribution in electrically heated volume-boiling systems.** Ginsberg, T. (Brookhaven Natl Lab, Upton, NY). pp 105-113 of Polyphase flow and transportation technology. New York, NY; ASME (1980).

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

Vapor generation rate functions for electrically-heated volume-boiling pool systems are derived based upon two models of their electrical response. It is shown that the parallel network model leads to the generally-used function in which the vapor production rate is proportional to the liquid fraction. Maxwell's distributed sphere model leads to another function, given in the paper. Measurements of the two-phase fluid resistivity were made in a uniform bubbling column. Void fractions up to 0.55 were studied. The resistivity data were shown to closely follow Maxwell's relationship. The vapor source term derived from Maxwell's distributed sphere model is, therefore, the appropriate function to use in electrically-heated volume-boiling pool systems. Void distributions in boiling pools were computed using the two source functions. 12 refs.

10912 **Recent advances and problems in EBR-II physics analyses.** Meneghetti, D. (Argonne National Lab., IL). pp 395-409 of Fast reactor physics, 1979. Proceedings Series. Vienna, Austria; International Atomic Energy Agency (1980).

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

The use and operation of the Experimental Breeder Reactor-II (EBR-II) as a fast-reactor facility for the irradiation of test fuels, structural materials and poisons have required continued effort towards improvement of physics analyzes and have frequently directed attention to problems requiring resolutions. Described are results and assessments of some recent examples of physics analyses in support of the EBR-II programs. Advances and problems in calculations of the outer blanket subassemblies, of the steel-containing regions such as structural test subassemblies and steel-reflector subassemblies, and of the run-to-run loading reactivities are described. Comparisons of measured values of test-element burnups and of measured in-blanket dosimetry with predictions are given. Regional-tailoring studies for irradiation enhancement and feasibility studies for possible use of EBR-II as a transient-test facility are also described. 5 figures, 2 tables.

10913 **(DOE/CEA/BMFT—26) Leak detection in steam generators of Phenix and Super Phenix reactors. Report DRNR/P/No. 011.** Cambillard, E. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). [nd]. 30p. (In French). NTIS (US Sales Only), PC A03/MF A01.

Water leak detection in steam generators of Phenix and Super Phenix reactors is based on measurement of hydrogen created out of sodium and water reaction. Hydrogen is released in sodium completely surrounding steam generators tubes; depending however on operating conditions, (sodium temperature and velocity) hydrogen may be noticed in argon existing above free levels. Therefore, although Phenix steam generators do not have free levels, controllers have been added to check hydrogen concentration in argon in expansion tanks. Super Phenix steam generators are equipped with measuring channels checking hydrogen contents in sodium at output as well as a measuring channel checking hydrogen contents in argon above free level. This report provides a description, complete with calibration and operating conditions, of equipment used to detect hydrogen in sodium and argon in steam generators of Phenix and Super Phenix reactors.

10914 **(DOE/CEA/BMFT—31) Minor water leaks testing system in the GRIGNOTIN sodium circuit. Report DRNR/P/No. 151.** Biscarel, J.; Chedeville, C.; Ferretti, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). [nd]. 22p. (In French). NTIS (US Sales Only), PC A02/MF A01.

The writers briefly describe the GRIGNOTIN circuit under construction on the sodium water testing site at SDGV/Cadarache, together with the various types of tests which may be carried out on this circuit.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

10915 **(LA—8649-PR) Reactor technology. Progress report, July-September 1980.** Breslow, M. (ed.). (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 58p. NTIS, PC A04/MF A01.

Progress in the Space Power Advanced Reactor (SPAR) Program includes indications that revision of the BeO reflector configuration can reduce system weight. Observed boiling limit restrictions on the performance of the annular-wick core heat pipe have accelerated transition to the development of the target-design arterial heat pipe. Successful bends of core heat pipes have been made with sodium as the mandrel material. With the phasing out of the GCFR Program, work on the Low Power Safety Experiments Program is now concentrated on completion of the third 37-rod Full Length Subgroup test. In the Reactor Safety/Structural Analysis area, effort on the Category I Structures Program is toward developing an experimental test plan focusing on a specific structural design. Buckling experiments on thin-walled cylindrical shells with circular cutouts are reported. Results of a three-dimensional analysis of thermal stresses in the Fort St. Vrain core support block are presented. Materials investigations and operation of a molybdenum-core SiC heat pipe are reported. Entrainment limits for gravity-assisted heat pipes and heat pipe configurations for application to energy conservation are being investigated. The new solution critical assembly, SHEBA, was completed. Godiva IV was temporarily relocated at TA-15. Influence of scattered radiations in the test vault on InRad measurements was determined from detector

scans of the vault produced by ^{252}Cf neutron and ^{137}Cs gamma sources.

2108 Economics

10916 (CONF-800334—(Vol.2), pp 1-18) **Environmental impact of radioactive releases from recycle of thorium-based fuel using current containment technology.** Tennery, V.J.; Bomar, E.S.; Bond, W.D.; Morse, L.E.; Meyer, H.R.; Till, J.E.; Yalcintas, M.G. (Oak Ridge National Lab., TN). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The analysis of thorium mining and milling suggests that the resulting doses should be similar to those from uranium operations. An absolute comparison cannot be made at this time, however, due to differences in some assumptions utilized by the various investigators and the lack in some cases of site-specific meteorology and population data at thorium resource sites in the western United States. A distinct difference resulting from the short half-life of ^{220}Rn (T/sub 1/2/ = 55.6 s) in the thorium decay chain compared to that for ^{222}Rn (T/sub 1/2/ = 3.82 d) in uranium decay was noted for emissions following mill shutdown. This effect is to make potential releases following thorium mill shutdown of lesser consequence than in the uranium case. Thorium tailings activity would also decrease relatively rapidly due to the comparatively short half-life (T/sub 1/2 = 5.75 y) of ^{226}Ra. Doses due to airborne releases from thorium-uranium carbide fuel refabrication are significantly less than that due to fuel reprocessing. Tritium is the principal contributor to reprocessing plant doses while carbon-14, ^{131}Cs, and ^{233}U account for most of the remaining dose. A tenfold increase in reprocessing plant CF for tritium reduces both individual and population doses by about 60%. For refabrication operations, a near linear dependence upon dose with ^{232}U content of the fuel was calculated between concentrations of 10 ppM and 5000 ppM. Comparison of (Th, U)C and (U, Pu)C showed little difference in dose commitment, but the presence of ^{232}U in the (Th, U) fuel causes a notable increase in the refabrication plant dose over that previously calculated for (U, Pu) type fuels.

10917 **(ORNL/Sub—7501/5) Economic incentives and recommended development for commercial use of high burnup fuels in the once-through LWR fuel cycle.** Stout, R.B.; Merckx, K.R.; Holm, J.S. (Exxon Nuclear Co., Inc., Richland, WA (USA)). Jan 1981. Contract W-7405-ENG-26. 170p. (XN-NF—79-87). NTIS, PC A08/MF A01.

Portions of document are illegible.

This study calculates the reduced uranium requirements and the economic incentives for increasing the burnup of current design LWR fuels from the current range of 25 to 35 MWD/Kg to a range of 45 to 55 MWD/Kg. The changes in fuel management strategies which may be required to accommodate these high burnup fuels and longer fuel cycles are discussed. The material behavior problems which may present obstacles to achieving high burnup or to license fuel are identified and discussed. These problems are presented in terms of integral fuel response and the informational needs for commercial and licensing acceptance. Research and development programs are outlined which are aimed at achieving a licensing position and commercial acceptance of high burnup fuels.

10918 **(ORNL/TM—7248) Reactor mass flow data base prepared for the nonproliferation alternative systems assessment program.** Primm III, R.T.C. (Oak Ridge National Lab., TN (USA)). Feb 1981. Contract W-7405-ENG-26. 412p. NTIS, PC A18/MF A01.

This report presents charge and discharge mass flow data for reactors judged to have received sufficient technical development to enable them to be demonstrated or commercially available by the year 2000. Brief descriptions of the reactors and fuel cycles evaluated are presented. A discussion of the neutronics methods used to produce the mass flow data is provided. Detailed charge and discharge fuel isotopics are presented. U_3O_8, separative work, and fissile material requirements are computed and provided for each fuel cycle.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 11792, 11800, 11803

10919 **(LA—8561-PR) Reactor technology. Progress report, April-June 1980.** Emigh, C.R.; Breslow, M. (ed.); Sullivan, S. (comp.). (Los Alamos Scientific Lab., NM (USA)). Nov 1980. Contract W-7405-ENG-36. 64p. NTIS, PC A04/MF A01.

Significant progress is reported in the Space Reactor (SPAR) Electric Power Supply Program with the initial testing of a 2-m-long molybdenum/sodium core heat pipe. Several performance limit points were obtained at temperatures above 1250 K. Work in the Gas-Cooled Fast Reactor Program is directed at completion of the FLS-3 experiments and, because of recent budgetary actions, orderly termination of all other effort. In the Reactor Safety/Structural Analysis area, work was completed on the Heavy Water Reactor seismic safety analysis and a final report sent to NRC. Effort in the Structural Margins to Failure Programs has focused on procuring information on Category I structures and structural systems and the experimental design for testing thin-walled steel cylinders with reinforced cutouts. Progress this quarter in the Heat Pipe Technology Development area has involved the expansion of materials investigation on the Ceramic Heat Pipe Program to encompass new working fluids and container materials. Nuclear Criticality Experiments and Safety reports submission of a proposal to DOE asking consideration of maintenance support for the Los Alamos Critical Assemblies Facility as part of a proposed National Criticality Safety Center. A new critical assembly, SHEBA, is being designed and fabricated to evaluate nuclear accident alarm dosimetry.

10920 **(LA—8636-PR) Transport and reactor theory. Progress report, July 1-September 30, 1980.** Dudziak, D.J.; O'Dell, R.D.; Alcouffe, R.E. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 87p. NTIS, PC A05/MF A01.

Research and development progress in transport and reactor theory by the Los Alamos Scientific Laboratory's Group T-1 for the fourth quarter of FY 80 is reported. Included are tasks in the areas of Fission Reactor Neutronics, Transport Methods Supporting Research, Reactor Safety Analysis, Fusion Reactor Nucleonics, and Shielding Methods.

10921 **Two-fluid model of two-phase flow in a pin bundle of a nuclear reactor.** Chawla, T.C.; Ishii, M. (Argonne Natl Lab, Ill). *International Journal of Heat and Mass Transfer ;* **23**: No. 7, 991-1001(Jul 1980).

The prediction of both single and two-phase thermal hydraulics of a pin bundle for thermal or fast reactors is of extreme importance both to the design and the safety of these reactors. Equations are proposed for two-fluid and two-phase flows in a pin bundle geometry. 25 refs.

2202 Components And Accessories

10922 **(DOE/ET/37240—80TR) MIT extraction method for measuring average subchannel axial velocities in reactor assemblies.** Hawley, J.T.; Chiu, C.; Todreas, N.E. (Massachusetts Inst. of Tech., Cambridge (USA)). Aug 1980. Contract AS02-76ET37240. 77p. NTIS, PC A05/MF A01.

The MIT extraction method for obtaining flow split data for individual subchannels is described in detail. An analysis of the method is presented which shows that isokinetic values of the subchannel flow rates are obtained directly even though the method is non-isokinetic. Time saving methods are discussed for obtaining the average value of the interior region flow split parameter. An analysis of the method at low bundle flow rates indicates that there is no inherent low flow rate limitation on the method and suggests a way to obtain laminar flow split data.

10923 (SAND—80-1887, pp 21-53) **Assessment of industry valve problems.** Jan 1981.

From EPRI/DOE workshop on nuclear industry valve problems; Washington, DC, USA (20 May 1980).

(This is a summary of EPRI Report NP-241.) Objective was to identify problems associated with valves in commercially operating nuclear power plants. Conclusions from forced outage data are listed. Maintenance on the valves is discussed, and the common valve modifications are described. Experience of utility personnel is summarized. Generic technical problems and their correction are discussed. Present practices for specifying and purchasing valves are summarized. The four principal conclusions of the general assessment and the resulting recommendations are listed. An update of Table B-2 (compilation of PWR and BWR shutdown data) is included. (DLC)

10924 **Type 304 stainless steel with 0.5% boron for storage of spent nuclear fuel.** Loria, E.A. (Cyclops Corp., Pittsburgh, PA); Isaacs, H.S. *Journal of Metals ;* **32**: No. 12, 10-17(Dec 1980).

For many years, Type 304 stainless steel with 1 to 2 wt. % boron has been used for control rods and thermal shielding of nuclear reactors, and for spent-fuel storage racks. There is current interest in Type 304 with 0.5 to 0.7% boron for the latter application; this paper presents a metallurgical evaluation at 0.53% boron. As measured by Gleeble hot tensile testing, strength of the alloy is no more than 25% higher than standard 304, but ductility is reduced over the 900 to 1180°C range and hence would require special care in hot working. A uniform density and concentration of particles occur at grain boundaries which are 1 or 6 microns, and which analyze approx. 50% chromium via EDAX/SEM. From the electrochemical measurements, it is apparent that Type 304 with 0.53% boron is susceptible to intergranular attack. In non-sensitized specimens, the presence of boride particles may either accelerate intergranular corrosion or tend to suppress it, depending upon the environment.

10925 **Apparatus for handling a cover of a steam generator in an electro-nuclear station.** Godart, J.L. US Patent 4,221,418. 9 Sep 1980. Filed date Jul 1978. vp.

The apparatus comprises a rigid frame which can rock about a fixed shaft and on which is mounted a transfer mechanism for imparting a translatory movement to the heavy plug so as to uncover the opening of the generator without irradiation of the personnel. A tool system for loosening the fixing nuts of the plug, as well as mechanical means for supporting or driving the sealing disc if the latter is separate from the plug, can be temporarily attached to the mechanism.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 11589, 11679

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 10907, 10953, 10954

10926 **(EGG—2074) Decontamination and Decommissioning of the SPERT-II and SPERT-III reactors at the Idaho National Engineering Laboratory.** Hine, R.E. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1981. Contract AC07-76ID01570. 28p. NTIS, PC A03/MF A01.

This report describes the Decontamination and Decommissioning (D and D) of the SPERT-II and SPERT-III reactor facilities performed during the period June through September 1980 at the Idaho National Engineering Laboratory. It includes a detailed description of the D and D accomplished and the post-D and D condition of the reactor facilities. The report also serves to document the radiological condition of the facilities after D and D, the waste volume generated and its disposition, and the project cost and schedule.

10927 **(HEDL-TC—1589) Comparison of SAND-II and FERRET.** Wootan, D.W.; Schmittroth, F. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1981. Contract AC14-76FF02170. 54p. NTIS, PC A04/MF A01.

A comparison was made of the advantages and disadvantages of two codes, SAND-II and FERRET, for determining the neutron flux spectrum and uncertainty from experimental dosimeter measurements as anticipated in the FFTF Reactor Characterization Program. This comparison involved an examination of the methodology and the operational performance of each code. The merits of each code were identified with respect to theoretical basis, directness of method, solution uniqueness, subjective influences, and sensitivity to various input parameters.

10928 **Installation of concrete expansion anchors at the Fast Flux Test Facility.** Clark, G.L. (Westinghouse Hanford Co, Richland, Wash). pp 263-272 of Effect of piping restraints on piping integrity. New York, NY; ASME (1980).

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

Installation criteria utilized at the Fast Flux Test Facility for concrete expansion anchors are presented. Static and dynamic load capabilities of various anchor types are discussed in relation to design loads, with particular emphasis placed on the yield load (the proportional limit). Effects of several variables (i.e., installation torque, hole diameter) are also investigated. Resolution and documentation of field problems are also described. Recommendations for improving and controlling future installations are given. 2 refs.

2207 Plutonium And Isotope Production Reactors

10929 **(ORNL/TM—7689) High flux isotope reactor. Quarterly report, January, February, and March, 1980.** Corbett, B.L.; Poteet, K.H. (Oak Ridge National Lab., TN (USA)). Feb 1981. Contract W-7405-ENG-26. 20p. NTIS, PC A02/MF A01.

Routine reactor operation with four end-of-cycle shutdowns and one unscheduled shutdown resulted in an on-stream time of 95.6% for the quarter. The outer control plates were replaced, and a new inner control cylinder was installed.

2208 Propulsion Reactors

REFER ALSO TO CITATION(S) 10351

2209 Reactor Safety

REFER ALSO TO CITATION(S) 10915, 11804

10930 **(ALO—134) Risk management and decision rules for light water reactor.** Griesmeyer, J.M.; Okrent, D. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Jan 1981. Contract AS04-78ET35400. 30p. NTIS, PC A03/MF A01.

The process of developing and adopting safety objectives in quantitative terms can provide a basis for focusing societal decision making on the suitability of such objectives and upon questions of compliance with those objectives. A preliminary proposal for a light water reactor (LWR) risk management framework is presented as part of that process.

10931 **(ANL—80-87) POLYFAIL: a program for identification of multiple fuel failures with gas tagging.** Gross, K.C. (Argonne National Lab., IL (USA)). Dec 1980. Contract W-31-109-ENG-38. 50p. NTIS, PC A03/MF A01.

This report describes the development of the computer code POLYFAIL for identification of fuel failures in fast reactors or light-water reactors that use gas tagging. POLYFAIL implements a sophisticated numerical algorithm known as the method of barycentric coordinates. The code can treat problems involving up to four simultaneous tag releases in a tagging system characterized by three independent tag ratios. The sensitivity of the multiple-failure-resolution technique has been optimized by incorporation of a newly developed ratio weighting scheme. Several example problems are provided to demonstrate operation of the code under single-leaker and various postulated multiple-leaker situations.

10932 (DP-MS—80-76) Calculation of hydraulic transients in SRP reactors by the GRASS code. Price, J.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 28p. (CONF-801107—62). NTIS, PC A03/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

Four types of postulated hydraulic transients were calculated for Savannah River Plant (SRP) reactors. The GRASS computer code was used, which calculates a three-dimensional reactor model with fully coupled neutronics and engineering feedback. The four types of transients calculated were: (1) a primary coolant pump shaft break, (2) loss of ac power to primary coolant pumps, (3) loss of power to secondary coolant pumps, and (4) closure of main coolant isolation valves. Nine cases of the four types of transients were calculated; calculations were continued beyond primary scram action until the backup shutdown system acted. The serices of GRASS calculations verified that the safety systems would terminate the transients before any steaming or assmbly damage occurred, indicate good agreement between calculated and experimentally measured flow in all cases where data were available, and verified analyses of some cases that were previously calculated by simpler codes.

10933 (EGG-PHY—5309) Physics calculations for the OPTRAN 1-1, 1-2, and 1-3 tests in the power burst facility. Olson, W.O.; Young, T.E. (Idaho National Engineering Lab., Idaho Falls (USA)). Jan 1981. Contract AC07-76ID01570. 88p. NTIS, PC A05/MF A01.

Fuel-pin power distributions (pin-to-pin and radially and azimuthally within each pin) and Figures-of-Merit (test powers per unit reactor power) have been calculated for Operational Transient (OPTRAN) Tests 1-1, 1-2, and 1-3. These tests are to be performed in the Power Burst Facility (PBF) reactor using pre-irradiated BWR/6 segmented test rods (except for two fresh heater rods in OPTRAN 1-2). This report details the pre-irradiation depletion analyses and the coupled Monte Carlo-S/sub n/ transport power distribution and Figure-of-Merit (FOM) calculations.

10934 (EGG-PHYS—5332) Kinetics calculations for RIA experiments in the Capsule Driver Core. Scott, A.J.; Nigg, D.W.; Judd, J.L.; Easson, S.A. (EG and G Idaho, Inc., Idaho Falls (USA)). Jan 1981. Contract AC07-76ID01570. 75p. NTIS, PC A05/MF A01.

Space-time kinetics calculations have been done for transient fuel behavior tests that were conducted during the late 1960's in the Capsule Driver Core in PBF. The purpose of the calculations was to determine the amount of energy deposited by delayed-neutron-fission in the test fuel after the power burst was terminated by control rod insertion. The kinetics calculations were done in two-dimensional (RZ) geometry with an EG and G Idaho version of the TWIGL two-group diffusion theory code. The delayed energy deposition was also computed with 33-group S/sub n/ transport theory using static methods. For these calculations, the one-dimensonal SCAMP program was used. Group constants for TWIGL and SCAMP were generated from ENDF/B IV data with the PHROG and INCITE multigroup spectrum codes. TWIGL results predict that 10.5 to 12.5% of the total energy deposited in the test fuel occurred after control rod insertion when the core was shutdown for reactor periods of 3 ms and 7.3 ms respectively. SCAMP results predict a delayed fraction that is 5 to 10% higher than the TWIGL results. A small uncertainty exists in both the TWIGL and SCAMP results due to an uncertainty in how far subcritical and the core was with the control rods fully inserted. The calculational models predict a cold core shutdown margin of 11$. From experiment, the shutdown margin was reported to be 9.3$. SCAMP calculations were done to evaluate the effect of this uncertainty on the delayed fraction. It was found that if the experimental shutdown margin were assumed correct, the TWIGL delayed energy fraction should be increased by about 8%.

10935 (EPRI-NP—1662) Evaluation of flow redistribution due to flow blockage in rod bundles using COBRA code simulation. Final report. Prelewicz, D.A.; Caruso, M.A. (NUS Corp., Rockville, MD (USA)). Jan 1981. 76p. NTIS, PC A05/MF A01.

During a Loss-of-Coolant Accident, fuel rod cladding may reach temperatures approaching 2200°F. At these temperatures, swelling and rupture of the cladding may occur. The resulting flow blockage will affect steam flow and heat transfer in the bundle during the period of reflooding. The COBRA-IV-I subchannel computer code was used to simulate flow redistribution due to sleeve blockages in the FLECHT-SEASET 21-rod bundle and plate blockages in the JAERI Slab Core Test Facility. Sensitivity studies were conducted to determine the effects of spacer grid and blockage interaction, sleeve shape effects, sleeve length effects, blockage magnitude and distribution, thermally induced mixing and bundle average velocity on flow redistribution. Pressure drop due to sleeve blockages was also calculated for several blockage configurations.

10936 (EPRI-NP—1684) Summary and evaluation of scoping and feasibility studies for disturbance analysis and surveillance systems (DASS). (Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1980. 92p. NTIS, PC A05/MF A01.

Disturbance Analysis and Surveillance Systems (DASS) are computer-based information systems which take in plant process and control data, process the data, and display results to the nuclear plant operating crew in a prioritized order of importance such that plant safety and availability are improved. Simultaneous and independent scoping and feasibility studies for a plant-wide DASS were performed by two design teams. The progress of each design team was guided by a technical advisory group (TAG) during a series of review and comment meetings which culminated in a critical evaluation of the results of both team designs. Descriptive summaries of the two design studies are presented along with introductory and background information on disturbance analysis. The review and evaluation process is described, and the results of the critical appraisal are highlighted according to key design factors identified by TAG.

10937 (EPRI-NP—1685) SPASM, a computer code for Monte Carlo system evaluation. Leverenz, F.L. (Science Applications, Inc., Palo Alto, CA (USA)). Jan 1981. 34p. NTIS, PC A03/MF A01.

SPASM (System Probabilistic Analysis by Sampling Methods) is a computer code in the WAM family which evaluates the distribution of system success or failure frequency via Monte Carlo simulation. It can be used independently of in conjunction with WAMCUT.

10938 (GA-A—16138) Safety Program Plan for the Gas-Cooled Fast Reactor. Torri, A.; Boyack, B.C.; Kelley, A.P. Jr. (General Atomic Co., San Diego, CA (USA); Helium Breeder Associates, San Diego, CA (USA)). Dec 1980. Contract AT03-76SF71023. 135p. NTIS, PC A07/MF A01.

The GCFR Safety Program has developed and adopted a probabilistic risk framework. This report defines a risk goal and quantifies the defense-in-depth concept by defining distinct lines of protection (LOPs). Each LOP has a quantitative frequency and consequence goal which is consistent with the overall risk goal. LOPs -1 through -3 are dedicated to preventing accidents. The normal operating systems constitute LOP-1. LOP-2 comprises the dedicated safety systems, and LOP-3 includes a new LOP made up of inherent safety features to prevent unusual events from progressing into severe accidents. LOPs -1 and -2 are design features normally in current nuclear power plants. LOPs -4 through -6 are dedicated to mitigating the consequences of accidents if LOPs -1 through -3 fail and lead to core melting. LOP-4 exploits the prestressed concrete reactor vessel (PCRV) as a barrier to contain accidents and to mitigate the release of activity. LOP-5 assures that the containment serves as an effective barrier against releasing activity to the environment if the LOP-4 barrier is postulated to fail. LOP-6 quantitatively reduces the consequences due to site and environmental effects, including emergency planning.

10939 (HEDL-TME—79-55) Intermediate-scale sodium-concrete reaction tests with basalt and limestone concrete. Hassberger, J.A.; Muhlestein, L.D. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1981. Contract AC14-76FF02170. 123p. NTIS, PC A05/MF A01.

Ten tests were performed to investigate the chemical reactions and rate and extent of attack between sodium and basalt and limestone concretes. Test temperatures ranged from 510 to 870°C (950 to 1600°F) and test times from 2 to 24 hours. Sodium hydroxide was added to some of the tests to assess the impact of a sodium hydroxide-aided reaction on the overall penetration characteristics. Data suggest that the sodium penetration of concrete surfaces is limited. Penetration of basalt concrete in the presence of sodium hydroxide is shown to be less severe than attack by the metallic sodium alone. Presence of sodium hydroxide changes the characteristics of sodium penetration of limestone concrete, but no major differences in bulk penetration were observed as compared to penetration by metallic sodium.

10940 **(LA-UR—81-237) TRAC development and assessment status.** Vigil, J.C.; Knight, T.D. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 13p. (CONF-810113—2). NTIS, PC A02/MF A01.

From Simulation methods for nuclear power systems conference; Tucson, AZ, USA (Jan 1981).

TRAC is being developed at the Los Alamos National Laboratory to provide an advanced systems code for light-water reactor accident analysis. The released TRAC versions (P1, P1A, and PD2) were intended primarily as benchmark codes for large-break loss-of-coolant accidents but PD2 has been applied successfully to TMI-type transients and other small-break transients. A fast-running version, PFI, is currently under development to address more efficiently and accurately these types of transients. All of the released versions have been subjected to testing against separate-effects, system-effects, and integral experiments covering a wide range of scales. Assessment results indicate that PD2 does a credible job overall; needed improvements are being addressed in PFI and in modifications to PD2.

10941 **(NUREG/CR—1451) Conceptual and programmatic framework for the proposed Nuclear Data Link.** Stiefeld, B. (Sandia National Labs., Albuquerque, NM (USA)). May 1980. 155p. NTIS, PC A08/MF A01.

The results of a conceptual design study of the Nuclear Data Link are reported. This system, proposed as a means of upgrading emergency response capabilities, would transmit and display at NRC headquarters about 100 parameters from each operating power reactor. Conceptual design and programmatic information as might be required by the Commission for a decision on major features and implementation are presented. The results indicated that an operational capability for the NRC portion of the system could be achieved in late 1982 at a cost of approximately $21 million. Licensee costs and schedules for implementing the data acquisition portion of the system have not been assessed.

10942 **(NUREG/CR—1462) Mechanistic considerations used in the development of the probability of failure in transient increases in power (PROFIT) pellet-zircaloy cladding (thermo-mechanical-chemical) interactions (pci) fuel failure model.** Pankaskie, P.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1980. 77p. NTIS, PC A05/MF A01.

A fuel Pellet-Zircaloy Cladding (thermo-mechanical-chemical) interactions (PCI) failure model for estimating the Probability of Failure in Transient Increases in Power (PROFIT) was developed. PROFIT is based on (1) standard statistical methods applied to available PCI fuel failure data and (2) a mechanistic analysis of the environmental and strain-rate-dependent stress versus strain characteristics of Zircaloy cladding. The statistical analysis of fuel failures attributable to PCI suggested that parameters in addition to power, transient increase in power, and burnup are needed to define PCI fuel failures in terms of probability estimates with known confidence limits. The PROFIT model, therefore, introduces an environmental and strain-rate dependent Strain Energy Absorption to Failure (SEAF) concept to account for the stress versus strain anomalies attributable to interstitial-dislocation interaction effects in the Zircaloy cladding.

10943 **(ORNL/CSD—73) Rare events: a state of the art.** Uppuluri, V.R.R. (Oak Ridge National Lab., TN (USA)). Dec 1980. Contract W-7405-ENG-26. 51p. NTIS, PC A04/MF A01.

The study of rare events has become increasingly important in the context of nuclear safety. Some philosophical considerations, such as the framework for the definition of a rare event, rare events and science, rare events and trans-science, and rare events and public perception, are discussed. The technical work of the Task Force on problems of Rare Events in the Reliability Analysis of Nuclear Plants (1976-1978), sponsored by OECD, is reviewed. Some recent technical considerations are discussed, and conclusions are drawn. The appendix contains an essay written by Anne E. Beachey, under the title: A Study of Rare Events - Problems and Promises.

10944 **(SAND—80-1887) Proceedings of EPRI/DOE workshop on nuclear industry valve problems.** Sprung, J.L. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 83p. (CONF-8005135—). NTIS, PC A05/MF A01.

From EPRI/DOE workshop on nuclear industry valve problems; Washington, DC, USA (20 May 1980).

Representatives from 29 nuclear industry organizations (11 valve manufacturers, 4 nuclear steam supply system vendors, 5 utilities, 3 national laboratories, 2 architect/engineering firms, the Department of Energy (DOE), EPRI, and 2 others) attended the workshop. Working sessions on key valves and on valve stem and seat leakage developed the following recommendations: (1) establish a small permanent expert staff to collect, analyze, and disseminate information about nuclear valve problems; (2) perform generic key valve programs for pressurized water reactors and for boiling water reactors, and several plant specific key valve programs, the latter to demonstrate the cost-effectiveness of such studies; (3) confirm the identity of, define, and initiate needed longer term research and development programs dealing with seat and stem leakage; and (4) establish an industry working group to review and advise on these efforts. Separate abstracts were prepared for three papers which are included in the appendix. (DLC)

10945 (SAND—80-1887, pp 54-61) **Study of valve failures which impact the safety and operation of light water nuclear power plants.** Tsacoyeanes, J.C.; Raju, P.P. (Teledyne Engineering Services, Waltham, MA). Jan 1981.

From EPRI/DOE workshop on nuclear industry valve problems; Washington, DC, USA (20 May 1980).

The data surveyed covers incidents reported over the six-year period, beginning 1973 through the end of 1978. Three sources of information on valve failures have been consulted: (1) failure data centers, (2) participating organizations in the nuclear power industry, and (3) technical documents. Results of this study indicate that frequent failure modes in valves include lack of leak tightness in both stem packing seals and valve seats, and operational malfunction resulting from problems with actuators, their power controls and instrumentation. The failure data analyses results are presented in tabulated form and a discussion of the information obtained from the three data sources is included. Recommendations are presented for future programs. Included is a statement of the objectives and a description of the major elements of the programs.

10946 (SAND—80-1887, pp 62-69) **Impact of valve failures on the safety and reliability of light water nuclear power plants.** Riddington, J.W.; Reyer, R.J. (Burns and Roe Inc., Oradell, NJ). Jan 1981.

From EPRI/DOE workshop on nuclear industry valve problems; Washington, DC, USA (20 May 1980).

A study of the causes of, and solutions for, recurrent valve failures has been performed. The frequency and root causes of valve problems were identified from licensee event reports and meetings with utility, NSSS, and valve manufacturer personnel. Three generic problems (stem leakage, seat leakage, and inadequate specification) and four valve specific problems were identified. The four valve specific problems and their principal causes are: (1) BWR pilot operated safety relief valves (pilot valve leakage); (2) spring loaded safety relief valves (water solid and two-phase flow behavior); (3) PWR feedwater regulating valves (trim degradation and packing failures); and (4) air operated solenoid valves (jamming due to foreign matter in service air). The first two valve specific problems are the subject of current industry programs. Programs intended to address stem leakage, seat leakage, timely exchange of

valve failure information, testing of valves, and adequate specification, selection, and maintenance of valves will be outlined.

10947 **(SAND—81-0047) Light water reactor safety technology program. Quarterly report VI, July-September 1980.** Dahlgren, D.A. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 59p. NTIS, PC A03/MF A01.

The Program was initiated in FY 1978 and has evolved during FY 1979 and FY 1980. The following areas of activity during the last quarter are reported: Management Support Program, Risk Methods Utilization, Improved Safety Systems, Man-Machine Interface, and Safety Data.

10948 **(UCID—18698(Vol.3)) Systematic evaluation program review of NRC safety topic VII-2 associated with the electrical, instrumentation and control portions of the ESF system control logic and design for the Dresden Station, Unit II nuclear power plant.** St. Leger-Barter, G. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Nov 1980. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01.

This report documents the technical evaluation and review of NRC Safety Topic VII-2, associated with the electrical, instrumentation, and control portions of the ESF system control logic and design for the Dresden Station Unit II nuclear power plant, using current licensing criteria.

10949 **(UCRL—84164) Survey of hydrogen monitoring devices.** Lai, W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1981. Contract W-7405-ENG-48. 19p. (CONF-810120—1). NTIS, PC A02/MF A01.

From Workshop on the impact of hydrogen on water reactor safety; Albuquerque, NM, USA (26 Jan 1981).

Presented are results of a survey of commercially available monitoring devices suitable for hydrogen detection in the secondary containment vessel of a nuclear power plant during the post postulated accident period. Available detectors were grouped into the following five classes: combustion, solid state, electrochemical, thermal conductivity, and absorption. The performance of most available sensors is likely to deteriorate when exposed to the postulated conditions which include moisture, which could be at high temperature, and radioactive noncondensibles. Of the commercial devices, those using metallic filament thermal conductivity detectors seem least susceptible to performance change. Absorption detectors are best suited for this monitoring task but the only available device is designed for pipeline corrosion assessment. Initiation of experimental study to assess apparent deficiencies of commercial detectors is recommended. Also recommended is an analytical/experimental effort to determine the optimum detector array for monitoring in the secondary containment vessels.

10950 **Three-dimensional characterization of falling liquid film using laser induced fluorescence.** Boiarski, A.A.; Liu, J.S.K.; Collier, R.P. (Battelle, Columbus Lab, Ohio). pp 137-145 of Polyphase flow and transportation technology. New York, NY; ASME (1980).

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

A new optical technique which can be employed in two- or three-dimensional characterization of falling liquid films has been developed. The location and subsequent motion of the film flow are used to determine the film flow characteristics. A preliminary experimental study has been performed involving the use of the one-dimensional version of this new technique. It is demonstrated that the present technique is appropriate for investigation of complicated steam-water flows. Good agreement is obtained between the experimental data measured with this technique and theory. Moreover, the local intensity method can be employed simultaneously to help define the interfacial transport processes associated with steam-water flows. 10 refs.

10951 **Centrifugal pump performance under simulated two-phase flow conditions.** Chen, T.H.; Quapp, W.J. (Edgerton, Germeshausen and Grier Inc, Idaho Falls, Idaho). pp 175-184 of Polyphase flow and transportation technology. New York, NY; ASME (1980).

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

This paper presents test results from centrifugal pump performance testing using nitrogen-water flow to simulate steam-water two-phase conditions. The results are compared with the predictions of the RELAP4/MOD6 pump performance model which is based on experimental data obtained from tests conducted on a small (radial-flow) pump. The purpose of this investigation is to obtain the two-phase characteristics of a mixed-flow pump and to evaluate the prediction capability of the pump model commonly used to analyze the thermal-hydraulic response when applied to a postulated loss-of-coolant accident in a light water reactor. Test results indicate that pump two-phase degradation is much less than that predicted by the RELAP4 model.

10952 **High-temperature pipe clamp applications in Japan.** Minami, H.M. Jr.; Inoue, T. (Rockwell Int, USA). pp 139-152 of Effect of piping restraints on piping integrity. New York, NY; ASME (1980).

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

A survey of the application of pipe clamps for high-temperature piping systems in Japan is presented. In particular, the design, analysis, and operating experience obtained in the use of clamps for thin-walled, nuclear-class piping are reviewed. Clamps designed for systems subjected to thermal transients differ from those used for isothermal piping. Examples of designs of both types are shown. 5 refs.

10953 **Insulated pipe clamp design.** Anderson, M.J.; Hyde, L.L.; Wagner, S.E.; Severud, L.K. (Westinghouse Hanford Co, Richland, Wash). pp 153-166 of Effect of piping restraints on piping integrity. New York, NY; ASME (1980).

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

Thin wall large diameter piping for breeder reactor plants can be subjected to significant thermal shocks during reactor scrams and other upset events. On the Fast Flux Test Facility, the addition of thick clamps directly on the piping was undesired because the differential metal temperatures between the pipe wall and the clamp could have significantly reduced the pipe thermal fatigue life cycle capabilities. Accordingly, an insulated pipe clamp design concept was developed. 5 refs.

10954 **Pipe clamp effects on thin-walled pipe design.** Lindquist, M.R.; Anderson, M.J. (Westinghouse Hanford Co, Richland, Wash). pp 167-176 of Effect of piping restraints on piping integrity. New York, NY; ASME (1980).

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

Clamp induced stresses in FFTF piping are sufficiently large to require structural assessment. The basic principles and procedures used in analyzing FFTF piping at clamp support locations for compliance with ASME Code rules are given. Typical results from a three-dimensional shell finite element pipe model with clamp loads applied over the clamp/pipe contact area are shown. Analyses performed to categorize clamp induced piping loads as primary or secondary in nature are described. 5 refs.

10955 **Use of benchmark criticals in fast reactor code validation.** Curtis, R. (Nuclear Regulatory Commission, Washington, DC); Kelber, C.; Gelbard, E.; Lesage, L.; Luck, L.; Smith, L.R.; Wade, D. pp 307-344 of Fast reactor physics, 1979. Proceedings Series. Vienna, Austria; International Atomic Energy Agency (1980).

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

Codes for the analysis of hypothetical core disruptive accidents either require significant ad hoc correction or angular quadrature to treat neutron transport through re-entrant voids. Moreover, changes in neutron spectrum motion may introduce an error whose bias changes during the described motion, again requiring ad hoc correction. The SIMMER code sponsored by the US NRC attempts to deal with these problems by using SN time-dependent neutronics with provision for cross-section revision via a Bondarenko-type procedure. The problem discussed here is how to check

the accuracy of SIMMER's neutronics treatment. A three-step process is used for code checking. Benchmark criticals in ZPR-9; Monte Carlo analog calculations to isolate errors arising from cross-section data and to establish a secondary standard; and comparison between the secondary standard, SIMMER neutronics, and other transport approximations, for configurations of interest. The VIM Monte Carlo Code is used as such a secondary standard. The analysis with VIM of the experiments in ZPR-9 using ENDF-B/IV cross-section data indicates that reactivity ramp rates at prompt critical may be substantially underpredicted if there has been substantial fuel or coolant movement and diffusion theory has been used. 8 figures, 10 tables.

25 ENERGY STORAGE

2502 Compressed Gas

10956 (CONF-800334—(Vol.2), pp 699-708) **Compressed air energy storage environmental control concerns program.** Beckwith, M.A.; Keizur, G.R.; Craig, R.A. (Pacific Northwest Labs., Richland, WA). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The components, operation and possible environmental impacts of storing off-peak electric power by means of compressed air storage in underground cavities are described, and demonstration programs for compressed air energy storage are discussed. (LCL)

10957 **(DOE/RA/50439—T1) CAES/UPH hybrid plant design study. Phase I.** (Acres American, Inc., Columbia, MD). Dec 1980. Contract AC02-80RA50439. 38p. NTIS, PC A03/MF A01.

In spite of the technical and economic feasibility of Compressed Air Energy Storage (CAES) and Underground Pumped Storage (UPH), there appears to be several barriers to their implementation and commercialization. These potential barriers include: large installed capacity is required to bring UPH plant economics into a favorable position and CAES requires consumption of petroleum distillate or natural gas. This study was undertaken to investigate means to remove these barriers by: identifying and evaluating the potential benefits that might be achieved by combining UPH, CAES and other related processes, and developing potential combination designs incorporating these benefits to determine their technical and economical feasibility. The development of specific UPH, CAES, and hybrid UPH/CAES concepts are discussed and evaluated. The results of the work performed to date show that development of conventional CAES and UPH design configurations is proceeding rapidly. The direction of this development will probably eventually result in a range of large scale energy storage plant types that will be attractive to electric utilities. However, the rate of development may be unacceptably slow for some of these variants to assist in effective reduction of distillate oil consumption for peaking power. It is recommended that an acceleration of the development rate of coal-fired CAES and adiabatic CAES concepts be organized. These two concepts, if adopted by electric utilities, could make a substantial contribution to the nation's effort to reduce oil imports. (LCL)

10958 **Altitude gas pressure differential power plant .** Kraus, E.J.; Kraus, R.A. US Patent 4,221,115. 9 Sep 1980. Filed date 23 Jan 1978. vp.

A device is described that operates on a closed gas power cycle between an upper and a lower horizontal datum plane, being separated through a distance of enormous height; comprising the steady-flow compression and the cooling of a suitable gas at the upper datum plane, and its reheating, and power-producing expansion through a compressor matched turbine at the lower datum plane; gravitational downward attractive force which is acting on the steady within a conduit downward-flowing mass of compressed gas, produces increased weight, which, in turn, produces a gravity-generated pressure, from the compressor discharge to the turbine inlet, a downwardly increasing gas pressure rise; the gravity-produced gas pressure rise produces in the compressed gas expansion at the lower datum plane a substantially greater amount of power than is consumed in the gas compression at the upper datum plane, thus resulting in a surplus generated power output.

2503 Pumped Hydro

REFER ALSO TO CITATION(S) 10957

2504 Capacitor Banks

10959 **Inductive transformer-type storage device.** Abramian, E.A. (to Osoboe Konstruktorskoe Bjuro Instituta (Union Of Soviet Socialist Republics)). US Patent 4,222,004. 9 Sep 1980. Filed date 1 Jun 1976. vp.

An inductive transformer-type storage device is described that is comprised of a primary winding and a secondary winding arranged inside the primary winding coaxially thereof. The secondary winding has a substantially greater number of turns than the primary winding and is enclosed in a hermetically sealed casing filled with dielectric having an electric strength of at least 50 kV/cm. The hermetically sealed casing also encloses the gap between the windings, which gap is selected so as to ensure the break-down strength in the dielectric, as well as an interwinding coupling factor of 0.2 to 0.8. The inductive storage device is intended for supplying power to installations generating powerful relativistic electron beams.

2505 Flywheels

10960 **(AD-A—087076) High energy density composite flywheel program. Final report Jun 76-May 80 on phase 2.** Sapowith, A.D.; Gurson, A.L.; McElman, J.A. (Avco Systems Div., Wilmington, MA (USA)). 30 May 1980. 155p. NTIS, PC A08/MF A01.

A bi-directional composite flywheel was instrumented with strain gages and tested to destruction. The flywheel was designed to exhibit constant stress in both radial and circumferential directions for all radial positions. Strain gage data verified this design. The burst speed was 38,741 rpm representing a specific energy level of 32.3 Wh/lb. The flywheel was constructed of Kevlar composite, had an outside diameter of 19.5 in., an axial thickness of 1.5 in and weighed 18.6 lbs. Premature failure was initiated at the inside diameter by excessive pressure exerted by a metal hub. A polyarylate hub design, with test data, is presented to solve this problem.

10961 **(CONF-801022—(Suppl.1)) 1980 flywheel technology symposium supplement.** (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 1980. Contract W-7405-ENG-48. 138p. NTIS, PC A07/MF A01.

From Flywheel technology symposium; Scottsdale, AZ, USA (19 Oct 1980).

Ten papers were presented at the meeting. A separate abstract was prepared for each paper. (LCL)

10962 (CONF-801022—(Suppl.1), pp 1-4) **Flywheel technology program in The Netherlands.** van Mourik, G.J. (Energy Research Foundation, Westerduinweg, Petten, The Netherlands). 1980.

From Flywheel technology symposium; Scottsdale, AZ, USA (19 Oct 1980).

The Netherlands Energy Research Foundation ECN has developed a national flywheel technology research and development program in cooperation with industry, research institutes, universities and utilities. The program, started in 1978, will be terminated in December of 1980 and is funded by the government. The program includes feasibility studies of different applications of flywheels, the development, construction and testing of different rotors, bearing and damper systems, assessment of housing requirements and motor/generation and converter systems. Finally, a hybrid flywheel unit of 0.7 to 1 kWh will be designed, constructed and tested. The results will be discussed.

10963 (CONF-801022—(Suppl.1), pp 5-39) **Flywheel rotor and containment technology development program of the US Department of Energy.** Kulkarni, S.V. (Lawrence Livermore National Lab., CA). 1980.

From Flywheel technology symposium; Scottsdale, AZ, USA (19 Oct 1980).

The status of the flywheel rotor and containment technology development program in the US sponsored by the Department of Energy, is reviewed in this paper. The specific objectives of the effort are delineated, and prototype composite rotor designs are described. These prototypes are being evaluated to identify promising designs for future development and end-use applications. The composite-laminated-rotor development effort at Lawrence Livermore National Laboratory (LLNL) and General Electric is also discussed, including design modifications to improve energy density, fabrication of thick composite laminates and filament-wound rings, low-cost manufacturing processes, generation of rotor-design data, nondestructive inspection, and spin testing of rotors. Finally, an assessment is made of the current rotor-burst-containment design philosophy and of the applicability of jet-engine fan-blade containment technology to flywheel systems. Based on this assessment, preliminary design criteria for containment are evolved.

10964 (CONF-801022—(Suppl.1), pp 57-67) **Design of a magnetic lifted 10-kWh flywheel.** Wilcock, D.F. (mechanical Technology Inc., Latham, NY). 1980.

From Flywheel technology symposium; Scottsdale, AZ, USA (19 Oct 1980).

An opposed permanent magnet thrust bearing for a vertical axis 1600-lb 10-kWh flywheel provides a means for substantially reducing the bearing power losses. Operation in a vacuum further minimizes windage. Small journal bearings provide radial support and damping, and a stationary viscous damper supports the magnetic thrust bearing. The calculated bearing drag gives the flywheel a time constant to half energy of 92.

10965 (CONF-801022—(Suppl.1), pp 81-92) **Nondestructive evaluation of fiber-reinforced composite panels and flywheels.** Maxfield, B.W.; Boyd, D.M.; Kulkarni, S.; Schwarber, A.J. (Lawrence Livermore National Lab., CA). 1980.

From Flywheel technology symposium; Scottsdale, AZ, USA (19 Oct 1980).

Several composite panels and flywheel designs were evaluated in support of the Mechanical Energy Storage Technology Project. Conventional nondestructive evaluation (NDE) technology was used on the panels and flywheels. All the flywheels and panels were radiographed and, where practical, were also inspected using ultrasonic techniques. The results provided information about the structural features of flywheels and materials. This information is useful for the quality control of fabrication procedures. The detection of apparent flaws in fabrication cannot be related to the ultimate strength until failure mechanisms in composite materials have been fully defined. Therefore, the location of detected flaws should be recorded for later comparison with dynamic and destructive evaluations.

10966 (CONF-801022—(Suppl.1), pp 93-101) **From vehicles to satellites: the technology revolution in high-performance flywheels.** Davis, D.; Csomor, A.; Ginsburg, B. (Rockwell International, Canoga Park, CA). 1980.

From Flywheel technology symposium; Scottsdale, AZ, USA (19 Oct 1980).

Over the past 10 years, dramatic technological advances in rotating machinery, materials, and fabrication techniques have resulted in the emergence of flywheel systems that truly merit being called Super Flywheels. Within this period, the rotating energy storage density of operational systems has increased over 500%, while new composite material configurations promise to boost this number above 1000% within the next few years. Some insight into these rapidly maturing high-energy-storage flywheel systems and describe pertinent flywheel programs in which Rockwell International has infused aerospace technology is provided.

10967 (CONF-801022—(Suppl.1), pp 102-114) **Avco constant stress flywheel design and test results.** Sapowith, A.D. (Avco Systems Division, Wilmington, MA). 1980.

From Flywheel technology symposium; Scottsdale, AZ, USA (19 Oct 1980).

A unique constant stress bu-directional composite design for high energy density flywheels was tested on 9 July 1979 at NAPC, Trenton, New Jersey. This design exhibited a specific energy level at burst of 32.3-w/lb and strain measurements taken during the spin test verified its constant stress characteristics. The design and detailed test results of this flywheel are described.

10968 (CONF-801022—(Suppl.1), pp 115-128) **Evaluation of flywheel containment.** Hickey, J.S.; Kerr, D.L. (General Electric Co., Schenectady, NY). 1980.

From Flywheel technology symposium; Scottsdale, AZ, USA (19 Oct 1980).

A program is described which was undertaken to provide a sound basis for defining the material, configuration, and dimensions of the containment structure to be used in the Flywheel Energy Storage System being developed for a transit bus by the General Electric Company. A brief description is included of the full size system which utilizes a multi-disc steel flywheel. The failure modes of concern, the procedure used to obtain a preliminary definition of the containment structure required to contain a flywheel rotor failure, and the rationale for deciding to implement a small scale containment test program to give more definitive answers to the containment design problem are also discussed. The small scale test program facilities and equipment are described as well as the test program and results up through early April 1980.

10969 (UCRL—15306) **Progressive matrix damage in laminated fiber-epoxy flywheel discs.** Nimmer, R.P. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). Mar 1980. Contract W-7405-ENG-48. 67p. NTIS, PC A04/MF A01.

The large value of strength to density ratio characteristic of composite materials relative to engineering metals has led to increased consideration for the application of composites to flywheel energy storage systems. In such an application the higher the strength to density ratio of the constituent, the more energy can be stored per pound of material. A program to design, fabricate and test composite flywheels has been conducted at the General Electric Research Laboratory. The test results accumulated to date and summarized herein have been lower than original expectations. As a result, an effort has been made to identify more realistic mechanisms to describe the failure of laminated discs. One mechanism which appears to provide insight into these early test failures is associated with damage to the epoxy matrix of the laminate rather than the embedded fibers. The analysis and rationale of this mode of failure is described and compared with experiment. It is evident that large percentages of the laminated flywheels made from both S2-glass and graphite epoxy incur matrix damage at speeds much below the ultimate falure speed. This prediction is corroborated by ultrasonic C-scans conducted on test wheels before and after spin tests. It is suggested that this damage which spreads rapidly over the disc as the speed of the flywheel increases may be one of the contributing factors to the failures of the test wheels observed to date.

10970 **Flywheel set for accumulating kinetic energy of rotation.** Theyse, F.H. (to Stichting Energieonderzoek Centrum Netherland (Netherlands)). US Patent 4,223,240. 16 Sep 1980. Filed date 28 Feb 1979. vp.

A flywheel set is described for accumulating energy with elastically supported bearings, resulting in a low critical speed, lying at all times under the operational flywheel speed. The axial thrust taking bearings, or one bearing, may be operating with magnetic forces.

2506 Thermal

REFER ALSO TO CITATION(S) 10701, 10702, 10703, 10704, 10898

10971 (DOE/ER/10343—02) **Fundamental heat transfer processes related to phase change thermal storage media.** Sparrow, E.M.; Ramsey, J.W. (Minnesota Univ., Minneapolis (USA). Dept. of Mechanical Engineering). Jan 1981. Contract AS02-79ER10343. 16p. NTIS, PC A02/MF A01.

Research on fundamental heat transfer processes which occur in phase-change thermal storage systems is described. The research encompasses both melting and freezing, and includes both experiment and analysis. The status of four research problems is discussed. One of the freezing problems was focused on investigat-

ing, via experiment, the extent to which freezing can be enhanced by the attachment of fins to the external surface of a cooled vertical tube situated in a liquid phase-change medium. Very substantial enhancements were encountered which neutralize the degradation of freezing due to the thermal resistance of the frozen layer and to natural convection in the liquid phase. The second of the freezing problems was analytical in nature and sought to obtain solutions involving both the phase-change medium and the heat transfer fluid used either to add heat to or extract heat from the medium. For freezing on a plane wall, it was possible to obtain a closed-form analytical solution, while for freezing about a coolant-carrying circular tube, a new numerical methodology was devised to obtain finite-difference solutions. For melting, quantitative design-quality heat transfer coefficients were determined experimentally for melting adjacent to a heated vertical tube. These experiments explored the effects of solid-phase subcooling and of open versus closed top containment on the coefficients. A dimensionless correlation enables these results to be used for a wide range of phase-change media. Studies on melting of a phase-change material situated within a circular tube are in progress.

10972 **(PNL—3581) Guidelines for conceptual design and evaluation of aquifer thermal energy storage.** Meyer, C.F.; Hauz, W. (General Electric Co., Santa Barbara, CA (USA). Center for Advanced Studies). Oct 1980. Contract AC06-76RL01830. 249p. NTIS, PC A11/MF A01.

Guidelines are presented for use as a tool by those considering application of a new technology, aquifer thermal energy storage (ATES). The guidelines will assist utilities, municipalities, industries, and other entities in the conceptual design and evaluation of systems employing ATES. The potential benefits of ATES are described, an overview is presented of the technology and its applications, and rules of thumb are provided for quickly judging whether a proposed project has sufficient promise to warrant detailed conceptual design and evaluation. The characteristics of sources and end uses of heat and chill which are seasonally mismatched and may benefit from ATES (industrial waste heat, cogeneration, solar heat, and winter chill, for space heating and air conditioning) are discussed. Storage and transport subsystems and their expected performance and cost are described. A 10-step methodology is presented for conceptual design of an ATES system and evaluation of its technical and economic feasibility in terms of energy conservation, cost savings, fuel substitution, improved dependability of supply, and abatement of pollution, with examples, and the methodology is applied to a hypothetical proposed ATES system, to illustrate its use.

10973 **Heat storage system and method.** Thomson, W.B. (to Rockwell International Corp). US Patent 4,222,365. 16 Sep 1980. Filed date 5 Jun 1978. vp.

A thermal energy storage system and method for storing substantial quantities of heat for extended periods of time is described. The system includes a heat collecting liquid which is in a heat exchange relationship with a source of heat or thermal energy, a housing containing a large volume of particulate material such as rocks for the storage of thermal energy, a heat transfer gas in a heat-exchange relationship with the rocks and means for causing the heat collecting liquid and the heat transfer gas to flow in counter-current, indirect heat-exchange relationship with one another, the means further includes provisions for reversing the direction of flow of the liquid and gas for the introduction and removal of heat from a portion of the body of rock. There further is provided a working fluid and means for passing the working fluid and heat collecting liquid in indirect, heat-exchange relationship with one another for the transfer of heat to the working fluid, and a means operatively associated with the working fluid to extract energy therefrom. In a particularly preferred embodiment, the source of heat comprises a solar heat collector which uses a liquid alkali metal as the heat collecting liquid and the preferred heat transfer gas comprises air.

10974 **Process for storing calories.** Perrut, M.; Ronc, M.; Valentin, P. (to Elf Union (France)). US Patent 4,221,259. 9 Sep 1980. Filed date 3 Jan 1979. vp.

A process is described for storing heat in the form of fusion/solidification latent heat which comprises passing a thermo-conductive fluid into a thermally insulated storage element containing a substance having a melting point that corresponds to the supply and heat consumption temperatures, characterized in that said fusible substance is absorbed on a microporous carrier which forms a granular bed in which the thermo-conductive fluid circulates.

10975 **Heat storage device.** Gawron, K.; Mahdjuri, F.; Schroder, J. (to U S Philips Corp). US Patent 4,220,196. 2 Sep 1980. Filed date 24 Apr 1978. vp.

A heat storage device is described that is comprised of a closed reservoir within which is positioned a flexible closed container of smaller volume. The flexible container encloses a liquefiable heat-accumulating material; and the reservoir is provided with a heat-transport medium outside of the flexible container. The heat-transport medium always remains in the liquid phase and, upon solidification and shrinkage of the heat-accumulating material, fills the spaces thus formed between the flexible container and the reservoir wall in order to maintain adequate transfer of heat.

10976 **Storage of cold water in aquifers.** Davison, R.R.; Harris, W.B.; Reddell, D.L. *AIChE Symposium Series ;* **76**: 34-40(1980). (CONF-791108—).

From 72. AICHE meeting; San Francisco, CA, USA (25 Nov 1979).

The advantages and mechanism of storing winter produced cold water in an aquifer for use in summer for cooling is described. This includes computer simulation of ideal aquifers, and the results of the one cycle of injection and withdrawal in an aquifer. Heat recovery was low because of regional flow, but otherwise performance was good. There was no evidence of well plugging, and the performance of the spray pond used to chill the water was excellent. 7 refs.

10977 **Extended cycling behavior of a direct contact--phase change TES system.** Mills, A.D.; Melsheimer, S.S.; Edie, D.D. (J.E. Sirrine Co, Greenville, SC). *AIChE Symposium Series ;* **76**: 41-46(1980).

The use of direct contact heat transfer in latent heat energy storage systems has been proposed as a means of combating phase segregation problems and enhancing heat and mass transfer performance in such systems. Recent studies have shown that several salt hydrates perform satisfactorily, and that acceptable heat transfer fluids are available. Studies of system geometry and heat transfer performance, as well as of crystal growth velocity, have also been completed. A report is presented on results obtained on a 2001 prototype unit which provides performance information under realistic operating conditions. 15 refs.

2509 Batteries

10978 **(AD-A—087390) DSCS II. battery anomaly investigation satellites 9437 and 9438. Final report.** Bauer, P.; Lurie, C. (TRW Defense and Space Systems Group, Redondo Beach, CA (USA)). 25 Apr 1980. 325p. NTIS, MF A01.

This report presents a description of the anomalous behavior of the electric power subsystems of DSCS II Satellites 9437 and 9438, and of the investigations conducted to determine the cause of the anomalies. These investigations include ground test simulations using flight-configuration batteries, component level testing, and analyses of components and systems. The investigations are described and the results discussed. The study concludes that the anomalous behavior was the result of battery cell short circuiting. The cause of the short circuiting is identified as excessive overcharge, its cause and the corrective actions taken are discussed.

10979 **(COO—2520-7) Low temperature alkali metal-sulfur batteries. Final report, December 1, 1974-November 30, 1978.** Brummer, S.B.; Rauh, R.D.; Abraham, K.M.; Dampier, F.W.; Subrahmanyam, V.; Pearson, G.F.; Surprenant, J.K.; Buzby, J.M. (EIC Corp., Newton, MA (USA)). Mar 1980. Contract AC02-76ET25003. 128p. NTIS, PC A07/MF A01.

Work on the development of rechargeable, ambient-temperature Li/sulfur and Li/metal sulfide batteries is reported. The Li/S

system has the cathode material dissolved in the electrolyte, as Li_2S/sub n/. Tetrahydrofuran, 1M $LiAsF_6$, is one of the more attractive electrolytes discovered for this cell, since it can dissolve up to ~ 10M S as Li_2Sn. Despite the oxidative nature of the electrolyte, Li is stable in it and can be electrodeposited from it on battery charge. Cells of the configuration Li 5M S (as Li_2S/sub n/), THF, 1M $LiAsF_6$/carbon can be discharged at 50°C with a utilization of nearly 1.5e^-/S at the C/3 rate. This corresponds to the rate-capacity goal for this battery in its proposed vehicular or load-leveling applications. Further improvements in rate are possible. Rechargeability of 135 cycles of 0.1 e^-/S and ~ 45 cycles of 0.5 e^-/S was demonstrated. The self-discharge reaction keeps the Li electrode free of electrically isolated dendrites. Ultimate failure on cycling is due to cathode depletion via precipitation of Li_2S on the anode in a form insoluble in the electrolyte. Attempts to solubilize the Li_2S by the internal generation of an oxidizing scavenger (e.g., Br_2) or by addition of Lewis acids have met only with limited success. Cells of configuration Li/THF, 1M $LiAsF_6$/insoluble metal sulfide were investigated, using the following cathodes: CuS, NiS, SiS_2, MnS_2, FeS, and Bi_2S_3. Of these, the most promising new material in terms of energy density and rechargeability is CuS. Well over 100 cycles for Li/CuS cells with moderate cathode loadings were demonstrated. CuS compares favorably with TiS_2 in terms of energy density and rechargeability and is superior in terms of economics. 39 figures, 19 tables.

10980 (COO—2564-6) Basic research on ceramic materials for energy storage and conversion systems. Progress report, December 1, 1979-November 30, 1980. Whitmore, D.H. (Northwestern Univ., Evanston, IL (USA)). Dec 1980. Contract AS02-76ER02564. 64p. NTIS, PC A04/MF A01.

The present research program involves utilizing appropriate experimental probes for measuring the movement of ionic and electronic charge carriers in ceramic materials suitable for solid electrolyte and electrode applications in high-performance, secondary battery and fuel cell systems. Special emphasis is placed on developing: (1) a better understanding of the effects of structure, impurities and composition on charge carrier transport mechanisms in such materials; and (2) detailed knowledge of the kinetics and mechanism of reactions occurring (on a microscopic scale) at the electrode-electrolyte interfaces of energy storage and conversion systems.

10981 Non-aqueous primary battery having a stannous sulfide cathode. Margalit, N.; Maroney, R.A. (to ESB Technology Co). US Patent 4,223,079. 16 Sep 1980. Filed date 9 Apr 1979. vp.

A non-aqueous primary battery comprised of an electrolytic solution of a solvent and a solute, a separator, an anode, and a stannous sulfide cathode is described. The electrochemical system of this invention is particularly useful in small primary batteries commonly referred to as "button cells" due to its high volumetric energy density and retention of cell dimensions.

10982 Composite electrode for storage batteries and the like. Faber, P. (to Rheinisch Westfalisches Elektrizitatswerk Ag (Germany)). US Patent 4,223,081. 16 Sep 1980. Filed date 17 May 1979. vp.

A metal/synthetic-resin composite electrode for a storage battery or the like is comprised of a perforate metal support which is flanked on both sides by openworks of polyolefin, e.g., partially fluorinated polyolefin, which are welded together within the openings of the support and carry the active material. The polyolefin openworks, together with the active material, are covered in turn with polyester fabric or polyester felt permeable fine porous cover layers.

10983 Battery charging circuit for an emergency system. Bulat, B. (to Chloride Inc). US Patent 4,223,232. 16 Sep 1980. Filed date 31 May 1978. vp.

A single active element performs the multiple functions of regulating dc voltage level from an ac source supplied to charge a battery and of coupling the battery to power an emergency system such as an emergency lighting system upon loss of the ac source. Preferably, the single active element also performs a third function of disconnecting the battery from the emergency system in time to prevent over discharge and consequent permanent damage to the battery.

10984 Means for controlling battery chargers. Ballman, G.C. US Patent 4,223,262. 16 Sep 1980. Filed date 12 Jun 1978. vp.

A battery charger control device is described that senses the placement of a battery across control terminals and utilizes the voltage thereof to place into conduction a transistor which actuates a relay which turns on a battery charger, which thereafter, monitors the the charge condition of the battery as determined by the voltage supplied to a voltage following circuit from the control terminals, and which actuates an electronic switch after the elapse of a predetermined period of time after the battery has attained a fully charged condition as determined by the voltage of the battery as presented to the voltage following circuit.

10985 Method of forming expanded metal grids particularly lead grids for storage battery plates. Cousino, B.A.; Cousino, W.E.; Redmon, J.T. (to Cousino Impact Corp). US Patent 4,221,032. 9 Sep 1980. Filed date 4 Apr 1979. vp.

The invention provides a novel method of formation and structure of a slitted strip of metal, such a lead, which is to be expanded into a reticulated configuration. As applied to a battery plate, the invention contemplates the formation of a continuous strip of a lead or lead alloy material wherein the central portion of the strip which is to form the unexpanded current collecting top header portions of the finished battery plates is provided with a plurality of longitudinally extending punched apertures extending along the edge of the solid central portion and separating the solid central portion from slitted portions of the strip which are subsequentially expanded to form a reticulated grid. The formation of the continuous lead strip in such fashion substantially minimizes the "gull-wing" effect produced by the subsequent expansion of the slitted portions of the lead sheet. By gull-wing effect is meant the tendency of the lead strip to curl about an axis transverse to the movement of the strip through the expanding mechanism.

10986 Battery separator. Armstrong, W.A.; Wheat, J.A. (to Canada National Defence Minister Of (Canada)). US Patent 4,221,846. 9 Sep 1980. vp.

The invention disclosed relates to a novel paper is a composition for use as a separator material in electrical batteries. The paper composition 30-50%/w of glass fibers and 70-59%/w of a copolymer of vinyl chloride and vinyl acetate.

10987 Method and apparatus for storage battery electrolyte circulation. Inkmann, M.S. (to Globe-Union Inc). US Patent 4,221,847. 9 Sep 1980. Filed date 4 Sep 1979. vp.

An electrolyte reservoir in fluid communication with the cell of a storage battery is intermittently pressurized with a pulse of compressed gas to cause a flow of electrolyte from the reservoir to the upper region of less dense electrolyte in the cell. Upon termination of the pressure pulse, more dense electrolyte is forced into the reservoir from the lower region of the cell by the differential pressure head between the cell and reservoir electrolyte levels. The compressed gas pulse is controlled to prevent the entry of gas from the reservoir into the cell.

10988 Electrochemical storage cell or battery of the alkali metal and sulfur type. Weddigen, G. (to Brown Boveri & Cie Ag (Germany)). US Patent 4,221,848. 9 Sep 1980. Filed date 22 Nov 1977. vp.

An electrochemical storage cell or battery is described that has at least one anode filled with a molten alkali metal as the anolyte and at least one cathode chamber filled with a sulfur-containing catholyte substance with the anode chamber and the cathode chamber separated from each other by an alkali-ion-conducting solid electrolyte. To the catholyte substance in the cathode chamber is added a chemical compound of the polar bond type which can charge the sulfur positively while absorbing electrons. This induces mobilization of the sulfur phase in the cathode chamber and prevents major accumulation of liquid sulfur as an insulator. As a result the cell can be repeatedly recharged with large currents to a greater capacity.

10989 **Storage battery with thermoplastic casing having internal members for immobilizing the battery plates.** Attinger, M.; Eisenacher, W.; Fraubose, F.; Makkens, L.; Niemann, G. (to Bosch, Robert Gmbh (Germany)). US Patent 4,221,850. 9 Sep 1980. Filed date 10 Nov 1976. vp.

Downwardly extending members are molded on the inside of a synthetic resin battery case cover and bear against the bridging members of battery plate assemblies or upward bulges of the battery plates to hold the latter vertically in place. The downwardly extending thermoplastic members may be heat-softened at their ends at the time the cover is fused onto the rest of the battery case, or they may be made so that they will flex at that time or they may be made of two members that will telescope together against strong pressure, so that they will still bear against the electrode plates after the cover has been fused onto the rest of the casing.

10990 **Radial grids for lead acid batteries.** Qureshi, N.M. (to ESB International Corp; ESB United States Inc). US Patent 4,221,852. 9 Sep 1980. Filed date 21 May 1979. vp.

A storage battery grid consisting of a frame having a lug on the upper edge thereof and spaced from a corner of the frame, a set of wires parallel to one another connecting the side edges of the frame, and a set of radial arms diverging away from the upper edge to connect that upper edge to each of the other three edges of the frame.

10991 **Lightweight laminated grid for lead-acid storage batteries.** Hammar, R.H.; Harvey, D.J. (to General Motors Corp). US Patent 4,221,854. 9 Sep 1980. Filed date 9 Feb 1979. vp.

Lightweight grids for lead-sulfuric acid type storage batteries are characterized by their laminated reticulated open meshed portions for retaining chemically active, lead-based paste materials. The laminated portions comprise a support layer of a rigid or semi-rigid plastic, an electrically conductive lead foil layer coextensive with the plastic layer, and a sulfuric acid resistant adhesive bonding layer between the plastic support and foil layers. In a preferred embodiment, the grid wires and nodes are twisted relative to the principal plane of the grid so that the lead foil layer is oriented to face the grid header portion and act as a ledge for retaining a desired battery paste. Such laminated grids may be rapidly and inexpensively formed by expanded metal processes of the type used to make battery grids made entirely of lead.

10992 **Battery heating system.** Silvertown, C.; Sinclair, W. (to Lucas Industries Ltd (United Kingdom)). US Patent 4,222,000. 9 Sep 1980. Filed date 6 Jul 1978. vp.

A battery heating system is comprised of a number of storage batteries and an alternator driven by a variable speed prime mover connected to supply ac heating current to the batteries. The system is arranged so that the ac current is substantially constant over the working speed range of the prime mover.

10993 **Apparatus for dumping and collecting corrosive substances from automotive batteries.** Eberle, W.J. (to General Battery Corp). US Patent 4,221,523. 9 Sep 1980. Filed date 27 Jun 1978. vp.

A novel battery dumping apparatus is described which is uniquely suited for dumping corrosive substances, such as battery acid, simultaneously from a number of batteries. The novel apparatus generally comprises a sealed tube adapted for rotation through an arc of less than 360 degrees for inverting batteries contained therein. Novel sealing and pouring means disposed at opposite ends of the tubular member provide for safe collection of the dumped corrosive liquids. Four inflatable members of novel construction are appropriately positioned within the tube for the purpose of selectively gripping groups of batteries to be inverted. The inflatable members are pressurized for engaging the batteries and are vented to an evacuated tank to release them. A novel hydraulic piston is utilized as a safety interlock to prevent batteries in the inverted position from being released by the inflated gripping members. Within the tube are disposed two parallel spaced apart baffles, which together form a sealed battery processing channel. This battery processing channel is pierced by a plurality of rods disposed in a plane which bisects the aforementioned baffles. These rods are ultimately caused to rotate in opposite directions by a gear drive disposed outside of said battery processing channel but within said tubular member. These gears are, in turn, caused to drive said rods by a pneumatic motor which is mounted outside of said tubular member.

10994 **Secondary zinc/oxygen electrochemical cells using inorganic oxyacid electrolytes.** Blurton, I.F.; Sammells, A.F. (to Institute Of Gas Technology). US Patent 4,220,690. 2 Sep 1980. Filed date 28 Jun 1979. vp.

A secondary zinc/oxygen electrochemical cell is described that uses a circulating aqueous inorganic oxyacid electrolyte and has an external load circuit or charging circuit in electronic communication with the anode and cathode, the circuit being completed by ionic interaction through an ionic separator between the catholyte and anolyte. The electrochemical cell of this invention provides a process for production of electricity and may be recharged by providing electrical energy from the external circuit.

10995 **Wick-and-pool electrodes for electrochemical cell.** Eberhart, J.G.; Faist, S.M.; Roche, M.F.; Ross, L.E. (to Dept. of Energy). US Patent RE 30,392. 2 Sep 1980. Filed date 7 Sep 1978. vp.

PAT-APPL-940,042.

An electrode system includes a reservoir of liquid-metal reactant, and a wick extending from a submersed location within the reservoir into the molten electrolyte of an electrochemical cell structure. The wick is flooded with the liquid metal and thereby serves as one electrode within the cell. This electrode system has application in high-temperature batteries employing molten alkali metals or their alloys as active material within an electrode submersed within a molten salt electrolyte. It also can be used in electrochemical cells where the purification, separation or electrowinning of liquid metals is accomplished.

10996 **Sodium sulfur cell.** Mitoff, S.P.; Roth, W.L. (to Electric Power Research Institute). US Patent 4,220,691. 2 Sep 1980. Filed date 25 Sep 1978. vp.

In a sodium sulfur cell, including a beta-alumina separator between the sodium and sulfur compartments, high surface area gettering means, e.g., beta-alumina or beta''-alumina, for potassium and alkali earth metal ion impurities are included in the sodium to protect the separator. The gettering means is disposed in the sodium container in the form of particles or a continous porous shell or porous solid plug adjacent to the separator.

10997 **Battery charger.** Quarton, W.T. (to Honeywell Inc). US Patent 4,220,905. 2 Sep 1980. Filed date 27 Jun 1978. vp.

A battery charging circuit includes a switching transistor which controls the flow of charging current to the battery at a high rate or a low rate. The operation of the transistor is, in turn, controlled by a voltage sensing circuit which includes a voltage detector module characterized in a very low current drain. The battery is, in fact, isolated from the charging circuit by a diode; the sensing circuit, however, is not isolated from the battery by a diode. This arrangement permits a more sensitive voltage detection and a more accurate control over the switching transistor. A desirable switching hysteresis is built into the sensing circuit but is operable to allow the hysteresis loop to be eliminated for purposes of calibration.

10998 **Rechargeable batteries: advances since 1977.** Graham, R.W. (ed.). Park Ridge, NJ; Noyes Data Corporation (1980). 462p. $54.00.

This book is based on US patents (including DOE patents) issued since January 1978 that deal with rechargeable batteries. It both supplies detailed technical information and can be used as a guide to the patent literature. Subjects treated are as follows: lead-acid batteries (grids, electrodes, terminals and connectors, polyolefin separators, polyvinyl chloride separators, other polymeric separators, other separators, electrolytes, venting techniques, hydrogen-oxygen recombination, general construction and fabrication), lithium batteries (metal chalcogenide cathodes, chalcogenide electrolyte compositions, chalcogenide batteries, lithium anodes, cathodes, lithium-thionyl chloride batteries, lithium-bromine batteries, electrolyte additives and other processes), sodium-sulfur batteries (general battery design, sulfur electrodes, sealing and casing design, current

collectors, other processes), alkaline zinc and iron electrode batteries (silver-zinc, nickel-zinc, air-zinc, other zinc electrode processes, iron electrode batteries), zinc-halogen batteries (electrodes, electrolyte additives, other zinc-halogen batteries, zinc-manganese dioxide acid electrolyte), nickel-cadmium and nickel-hydrogen batteries (nickel-cadmium electrodes, other processes for nickel-cadmium batteries, nickel-hydrogen electrodes, other processes for nickel-hydrogen batteries, other nickel-containing batteries), and other battery systems (battery systems and design, other processes). (RWR)

10999 **Electrochemistry of molten lithium chlorate and its possible use with lithium in a battery.** Wang, S.C.S. Los Angeles, CA; Univ. of California (1979). 117p. University Microfilms Order No. 80-08,551.

Thesis (Ph. D.).

Lithium chlorate melts at about 128°C, and is a possible electrolyte for a new lithium battery system that operates between 130°C and 150°C. A rotating disk was used to investigate anodic and cathodic reactions occurring at positive electrodes in molten lithium chlorate cells. Three anodic plateaus, 2.9V, 3.4V,and 4.6V, and one cathodic plateau at around 2.5V were observed for a Ni rotating disk. For a Pt rotating disk, three different anodic plateaus, at 3.4V, 4.2V, and 4.6V, were observed while the cathodic curves were about the same as those obtained for Ni. Li_2O and LiCl are formed cathodically from $LiClO_3$ on either Ni or Pt positive electrode. Two anodic reactions were observed on the Ni positive electrodes, Ni dissolution and O_2 evolution from Li_2O. On Pt positive electrodes, chlorine evolution from either LiCl or $LiClO_3$ was observed during anodic polarization in addition to the oxygen evolution. It is concluded that $LiClO_3$ is stable in the potential range between 3.2V and 4.6V. The Li-Cl_2 secondary battery system has a open curcuit potential around 3.97V with a theoretical specific energy of 2465 Wh/kg based on a discharge potential of 3.9V. Operation of a Li-Cl_2 secondary battery in molten $LiClO_3$ is, in principle, possible. A $LiClO_3$ primary battery system is also possble. Whith an energy density of 3898 Wh/kg based on a discharge potential of 3.2V, the lithium chlorate primary battery is theoretically one of the highest specific energy primary battery systems available.

29 ENERGY PLANNING AND POLICY

REFER ALSO TO CITATION(S) 11021, 11862, 11863, 11864

11000 **(CONF-800780—(Vol.1)) Energy awareness luncheon and energy seminar.** (National Society of Professional Engineers, Washington, DC (USA)). 23 Jul 1980. 157p. NTIS, PC A08/MF A01.

From 46. National Society of Professional Engineers annual meeting; Detroit, MI, USA (20 Jul 1980).

A separate abstract was prepared for each of the following: the luncheon address, energy-growth-freedom by Kenneth A. Randall; the keynote commentary, by F.S. Patton, program chairman; and four current-awareness papers on the future of oil and gas, coal, nuclear energy, and solar energy. In addition, in a section, Speaking of Energy, very brief statements by eight professional engineers on the energy challenge are included. Also, the NSPE position paper on energy policy is included.

11001 **(DOE/S—0010(81)(Vol.1)) Secretary's annual report to Congress. Volume I. Posture statement, outlook and program review.** (Department of Energy, Washington, DC (USA)). Jan 1981. 244p. NTIS, PC A11/MF A01.

Activities of all elements of the Department of Energy (DOE) except those of FERC are reported. Chapter I, the Posture Statement, gives an overview of the policies, programs, and strategies of DOE. It describes the national energy policy and its effects, sets out the current state of energy supply and demand in the US and around the world, describes the present assessment of future energy availability, and outlines the strategy for 1982. Additional chapters detail the major programs in the following Offices or Assistant Secretaryships: Conservation, Fossil Fuel, Nuclear Energy, Renewable Energy Resources, Electric Energy Systems and Energy Storage, Environment, Energy Supporting Research, Energy Production and Power Marketing, Energy Information, Economic Regulation, General Science, Defense, International Programs, Nuclear Non-Proliferation, Energy Contingency Planning, and Administration. Information is included in appendices on foreign direct investment in US energy sources and supplies for 1979, exports of energy resources by foreign companies, major recipients of DOE funding, DOE actions taken regarding disclosure of energy assets by DOE employees, and financial assistance programs. (MCW)

11002 **(DOE/S—0010(81)(Vol.3)) Secretary's annual report to Congress. Volume III. Project summaries.** (Department of Energy, Washington, DC (USA)). Jan 1981. 132p. NTIS, PC A07/MF A01.

Progress and status of representative projects in each program within DOE are summarized. Subjects covered and the number of projects reported on are: conservation (2); fossil energy (11); nuclear energy (5); renewable energy resources (16); energy production and power marketing (3); general science (11); defense programs (7); contingency planning (3); and management and oversight (1). (MCW)

11003 **(UCRL—52540(Rev.1)) Energy and resource planning: report abstracts.** Borg, I.Y. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Dec 1980. Contract W-7405-ENG-48. 40p. NTIS, PC A03/MF A01.

Abstracts of chronologically arranged reports written by the Energy and Resource Planning Group at LLL are presented. Categories of reports and the number are: Energy (31); Foreign Energy Developments (4); Energy Modeling (20); Resources and Resource Development (17); Transportation (28); Technology Applications (19); Biological Resources/Fuels (4). Six annual reports are cited. (MCW)

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 10195, 10226, 10227, 11013, 11047, 11069, 11153, 11154, 11170, 11184

11004 **(BNL—51006) Brookhaven Regional Energy Facility Siting Model (REFS): model development and application.** Meier, P.; Hobbs, B.; Ketcham, G.; McCoy, M.; Stern, R. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). Jun 1979. Contract AC02-76CH00016. 325p. NTIS, PC A14/MF A01.

A siting methodology developed specifically to bridge the gap between regional-energy-system scenarios and environmental transport models is documented. Development of the model is described in Chapter 1. Chapter 2 described the basic structure of such a model. Additional chapters on model development cover: generation, transmission, demand disaggregation, the interface to other models, computational aspects, the coal sector, water resource considerations, and air quality considerations. These subjects comprise Part I. Part II, Model Applications, covers: analysis of water resource constraints, water resource issues in the New York Power Pool, water resource issues in the New England Power Pool, water resource issues in the Pennsylvania-Jersey-Maryland Power Pool, and a summary of water resource constraint analysis. (MCW)

11005 **(EUR—6759) Implementation of the program DECOMPSX SOUS OS.** Culot, B.; Loute, E. (Universite Catholique de Louvain, Louvain-la-Neuve (Belgium)). 1980. 120p. (In French). NTIS (US Sales Only), PC A06/MF A01.

Implementation of the algorithm of decomposition, with the long-term objective of using it to resolve linear programs of large size within the framework of models in the energy sector of the EEC, is discussed. One of the principal routines for implementing the algorithm is the routine for treatment of linear programs defined in the algorithm. The advantage of the approach chosen is that all algorithmic improvements in the simplex method can be utilized in the algorithm of decomposition. Two matters of importance are emphasized: (1) the programs written in modular fashion allow the user to construct his own algorithm using the tools at his disposal, opening up a much greater number of applications than were

foreseen before its initiation; and (2) the method of decomposition may be programmed to provide the means for making similar modifications in a linear program code. The program DECOMPSX is almost complete; aspects still needing to be developed are: (a) special strategies to allow an appreciable gain of time, as regards the major cycles, e.g., by only resolving the most-active subproblems etc.; and (b) the form of the limited master program should be periodically controlled and reduced in size by eliminating propositions which are not active.

11006 **(UCID—18914) Market-share algorithm used in the Livermore Economic Modeling System.** Bell, R.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Jan 1981. Contract W-7405-ENG-48. 23p. NTIS, PC A02/MF A01.

The methodology and implementation are outlined and several examples of possible paradoxial behavior are given for the Market-Share allocation scheme used in the Livermore Economic Modeling System. A means to potentially improve the allocation method is discussed.

11007 **Comparative analysis of global energy models.** Allen, E.L. (Inst. for Energy Analysis, Washington, DC); Edmonds, J.A.; Kuenne, R.E. *Energy Economics ;* **3**: No. 1, 2-13(Jan 1981).

A comparative analysis is presented of seven leading models concerned with forecasts of worldwide energy demand to 1985. There are wide variations in the model's projections of non-communist world demands for OPEC petroleum in 1985. This variation is attributed to differences in assumptions about economic growth and about energy-utilization rates. It is concluded that differences in assumptions about economic growth were less important than those about energy-utilization rates. Variations in petroleum-demand projections were attributed to different assumptions about economic growth, energy utilization and interfuel substitution possibilities. Variations in assumptions about the latter prove to be the largest single source of differences. Supply assumptions accounted for almost none of the differences between projections. 19 references, 2 figures, 7 tables.

11008 **Energy, GNP and causality: a statistical look at the issue.** Uri, N.D. (US DOE, Washington, DC). *Energy Communications ;* **6**: No. 1, 1-15(1980).

It is typical to treat the relation between energy consumption and economic activity as bidirectional. This paper formally tests this and concludes that while fluctuations in economic activity unequivocally affect energy consumption, the reverse is not necessarily true. That is, energy conservation, from whatever source, does not necessarily mean an alteration in the rate of economic growth and employment. 7 refs.

11009 **Energy management system for the state of New Mexico. Final report.** Lievano, R.J.; Ben-David, S. Albuquerque, NM; University of New Mexico (1980). 389p. (NP—25249). EMIS-Resource and Development Div., Santa Fe, NM.

The EMS of New Mexico consists of a number of distinct models which can be operated in concert to provide a consistent methodology for the evaluation of the consequences of alternative energy policies and development strategies for the economy and population of the state. The nine models that are in the set are discussed in detail in separate chapters. The models are: Southwest Water, Economy, Energy, and Population Model (SWEEP); Econometric Final Demand; Resource Taxation; Electrical Generation Linear Program; Petroleum and Natural Gas Linear Program; Uranium Linear Program; Petroleum and Natural Gas Supply; Coal Supply, and Uranium Supply.

2902 Economics And Sociology

11010 (CONF-801213—(Prelim.), pp 334-518) **Part three: community/economic development.** Dec 1980.

From Local alternative energy futures-developing economy building communities conference; Austin, TX, USA (11 Dec 1980).

In a section on equity issues, the following are discussed: energy needs of low-income persons and governmental response to such needs; New York City's support of multi-family retrofits; low-income energy assistance; rental weatherization; the Minneapolis study showing that energy costs will soon outstrip mortgage payments; energy development impacts in rural America; and boom town issues. Correlations of jobs and energy are discussed with specific information on solar energy, energy conservation, the gas industry, and jobs created through energy policy. Information dealing with community energy planning includes measuring community cash flow, economic analysis for local governments, soft-energy studies, programs on planning and renewable-energy planning, community-based technology assessment, and local government energy-conservation programs. Citizen participation in community energy planning is discussed with specifics of the St. Paul program. Specific experiences at Anacostia, San Bernadino, and the New England Community Energy Co-Ops on community/economic development options are followed. Discussions on rural energy issues include subjects on farms, community-based technology, and establishment of a Rural Development Institute by the Mexican American Research Center. To discuss alternative energy resources and technologies, emphasis is on energy conservation, solar energy, ridesharing, mass transit, bicycling, resource and waste heat recovery, district heating, and biofuels. Information resources are summarized with an Energy Information Resource Inventory included. (MCW)

11011 **(ORAU/IEA—80-16(M)) Energy demand and population changes.** Allen, E.L.; Edmonds, J.A. (Oak Ridge Associated Universities, Inc., TN (USA)). Dec 1980. Contract AC05-76R00033. 19p. NTIS, PC A02/MF A01.

Since World War II, US energy demand has grown more rapidly than population, so that per capita consumption of energy was about 60% higher in 1978 than in 1947. Population growth and the expansion of per capita real incomes have led to a greater use of energy. The aging of the US population is expected to increase per capita energy consumption, despite the increase in the proportion of persons over 65, who consume less energy than employed persons. The sharp decline in the population under 18 has led to an expansion in the relative proportion of population in the prime-labor-force age groups. Employed persons are heavy users of energy. The growth of the work force and GNP is largely attributable to the growing participation of females. Another important consequence of female employment is the growth in ownership of personal automobiles. A third factor pushing up labor-force growth is the steady influx of illegal aliens.

11012 **(PB—80-179765) State financial management resource guide.** Mann, T.; Coleman, S. (Council of State Community Affairs Agencies, Washington, DC (USA)). Jan 1980. 187p. NTIS, PC A09/MF A01.

This resource guide contains almost 500 references to training sessions, workshops, and publications which have been sponsored and provided by 108 statewide financial management assistance providers in the 50 States. These include the programs of State - level Departments of Community Affairs, other State agencies, university extension services, State municipal leagues, county associations, and other professional groups. The guide can be used to provide information to local officials within a State about sources of assistance in financial management and to guide States wanting to expand or modify their local government financial management approaches. The guide is organized by State with a brief summary of the activities of the financial management assistance providers for each jurisdiction. The activities of the providers have been categorized into three levels of assistance: ongoing financial management assistance; workshops, training sessions, and seminars; and publications. A subject index serves as a reference guide as does a matrix displaying the statewide technical assistance provisions in the financial management area.

11013 **Descriptive documentation for Southwest Water, Economy, Energy, and Population Model (SWEEP).** Santa Fe, NM; New Mexico Energy and Minerals Department (1981). 47p. (NP—25227).

SWEEP contains a multiregional framework which depicts the interrelationships among 12 delineated regions in New Mexico. It is capable of consistently accounting for the region-specific implications of national developments for the southwest and of southwestern developments for the subregions of New Mexico. For the

purposes of the model the southwest is spatially defined as New Mexico and the four surrounding states: Arizona, Colorado, Utah, and Texas. New Mexico is further disaggregated below the state level by planning district in light of the cultural disparities in different areas of the state and the different problems and objectives they imply, and because state policy implementation frequently involves consideration of specific sub-state locations. The rest of the United States is treated as a residual region in the model. The model specifically provides an accounting framework for depicting structural change, especially in energy-related areas; accounts consistently for regional implications of national energy and environmental policy; and is compatible with more-detailed micro models of New Mexico energy resources, especially linear-programming-type models of energy industries for the purpose of providing a practical policy tool for state agencies in New Mexico.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 11004, 11087, 11147, 11148, 11544, 11575, 11598, 11679, 11681, 11693

11014 **(PB—80-185010) National energy needs and environmental quality. Progress report 1 Aug 70-31 Jan 71.** Comar, C.L. (Cornell Univ., Ithaca, NY (USA). Cornell Energy Project). 1971. 158p. NTIS, PC A08/MF A01.

Tasks described are as follows: (1) socioeconomic studies related to the development of organizational requirements for interdisciplinary research, analysis of public utility investment, and development of an optimum strategy model; (2) compilation of a consistent data base on the status of energy and its sources; (3) exploration of heat dissipation from cities and complexes as a limiting factor for energy production; (4) reassessment of the technology power; (5) reviews of the biological and ecological costs of the nuclear power industry; and (6) a literature survey of health and environmental problems related to air pollution and ionizing radiation.

11015 **(PB—80-186083) Incentives for technological innovation in air pollution reduction: an ETIP (experimental technology incentives program) policy research series. Volume 2: Market mechanisms for emission regulation and enforcement of emission limits: deterrence and demand.** (Performance Development Inst., Washington, DC (USA)). May 1980. 32p. NTIS, PC A03/MF A01.

This report focuses on the necessity of strong enforcement of air pollution emission limits for the creation of a marketplace demand for market mechanisms, such as offsets. Both trading and direct pricing types of market mechanisms for stationary source emission reduction will require strong, even enforcement of individual source emission limits. Enforcement will likewise influence the degree to which the private sector will organize and invest in the research and development work underlying technological innovation in air pollution control. Present enforcement inconsistencies, such as those among regional offices, and remedial actions are noted. If an EPA effort to strengthen detection of violations can be successfully implemented, its effect on a regulatee's perceived probability of getting caught could contribute to market participation. If the probability of detection and penalty is high, purchase of emission reductions on the market may be a more appealing alternative to regulatees than evasion or litigation.

11016 **(PB—80-187222) Office of research and development program guide, fiscal year 1980. Report for 1 Oct 79-30 Sep 80.** (Environmental Protection Agency, Washington, DC (USA)). Oct 1979. 91p. NTIS, PC A05/MF A01.

The Program Guide provides the public with information on the Office of Research and Development's current extramural research program. It describes each of the major budget units, the funds associated with each, and the responsible laboratory(ies). In addition, the Guide contains an organizational directory of each laboratory/office, as well as a list of who to contact in each of EPA's regional offices.

11017 **New laws, new concerns and new technologies.** Reznek, S.R. pp Paper 37, 489-497 of Energy: the new rules. Newman, D.T. (ed.). Santa Monica, CA; Management Education Corporation (1979).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

The political climate within which the issues of environmental regulation and the national economy are now being debated is investigated. In order to identify the root causes of inflation, much attention is being focused on Federal regulations, and emphasis on Environmental Protection Agency regulations is prominent. It is believed by EPA personnel that the debate should focus on regulatory methods, their effectiveness, and the associated costs. The purpose of the President's Regulatory Council is discussed. It is then pointed out that regulations need not be inflationary. The economic fact is that regulations are not inflationary if their benefits exceed the cost. Apparent regulatory reform at EPA is reviewed. (MCW)

2904 Natural Resources

11018 **(PB—80-185986) Contracts to provide space in Federal reservoirs for future water supplies should be more flexible.** (General Accounting Office, Washington, DC (USA). Community and Economic Development Div.). 16 May 1980. 22p. NTIS, PC A02/MF A01.

The report discusses Federal contracting procedures for municipal water supply storage at Federal reservoirs and the need to include cost estimates for transporting such water to the user's treatment facilities. It suggests ways to improve current contracting procedures and allow the Federal Government to market unneeded water to other users.

11019 **(SPE—9553) How policies affect the rates of recovery from mineral sources.** Lohrenz, J.; Burzlaff, B.H.; Dougherty, E.L. (Geological Survey, Denver, CO (USA); Systems Technology, Inc., Paonia, CO (USA); California Univ., Los Angeles (USA)). 1981. 25p. (CONF-810207—1). Society of Petroleum Engineers, AIME, Dallas, TX.

From SPE economics and evaluation symposium; Dallas, TX, USA (25 Feb 1981).

An investor is considered who, knowing future costs and revenues, can choose how rapidly to produce from a given mineral source. If the investor elects to make that choice to maximize present value of future profits, how do policies affect the choice. Various alternative policies are examined. Some, such as higher royalty rates, lead to slower production rates than would otherwise obtain. Clearly, the chosen rates of production are policy-dependent. One is wisely counseled to consider how mineral policies affect the rate of production from given sources when analyzing current and alternative policies.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 10239, 10316, 11001, 11002, 11056, 11057, 11081

11020 (CONF-800780—(Vol.1), pp 1-5) **Energy-growth-freedom.** Randall, K.A. (Conference Board, Inc., New York, NY). 23 Jul 1980.

From 46. National Society of Professional Engineers annual meeting; Detroit, MI, USA (20 Jul 1980).

Luncheon address.

Current fears of the risks associated with energy development and use overlook that they are the price of enjoying the benefits of technology. The call for zero growth cannot be ignored because its appeal diverts us from national goals and leads to inaction. The US economy must grow by 2.5% each year just to sustain the present level of jobs and the living standard. The suggestion that we can forego nuclear energy with zero growth policies is unacceptable unless we ae willing to give up the freedom of our present life style. The fear of technology must be dealt with through an information and educational effort that the public can understand and that will expand the public's vision. (DCK)

11021 **(DOE/CS—0206) Futures for energy cooperatives.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy). Jan 1981. 93p. NTIS, PC A05/MF A01.

A listing of Federal agencies and programs with potential funding for community-scale cooperatives using conservation measures and solar technologies is presented in Section 1. Section 2 presents profiles of existing community energy cooperatives describing their location, history, membership, services, sources of finance and technical assistance. A condensed summary from a recent conference on Energy Cooperatives featuring notes on co-op members' experiences, problems, and opportunities is presented in Section 3. Section 4 lists contacts for additional information. A National Consumer Cooperative Bank Load Application is shown in the appendix.

11022 **(PB—80-13175-8) Advisory Committee on Industrial Innovation. Final report.** (Department of Commerce, Washington, DC (USA)). Sep 1979. 304p. NTIS.

An increase in industrial innovation will contribute significantly to the reduction of inflation, the creation of jobs, the improvement of the country's balance of trade position, and the ability of the nation to conserve natural resources and reduce reliance on non-renewable energy resources. This report compiles the reports of the various industrial subcommittees and encompasses the following areas: economic and trade policy; environmental, health, and safety regulations; regulation of industry structure and competition; Federal patent and information policy; and Federal procurement policy and direct Federal support of research and development. The final three sections are devoted to: (1) special report on small business; (2) report of the labor subcommittee; and (3) report of public-interest subcommittee. (MCW)

2906 Nuclear Energy

11023 (CONF-800780—(Vol.1), pp 53-60) **Future prospects for nuclear energy.** Weaver, L.E. (Georgia Inst. of Tech., Altanta). 23 Jul 1980.

From 46. National Society of Professional Engineers annual meeting; Detroit, MI, USA (20 Jul 1980).

Nuclear energy contributes 3.5% of the total energy budget (up to 80% regionally) at a lower cost per kilowatthour than coal or oil. Energy supply-and-demand projections indicate that nuclear power will be necessary as oil and gas are depleted because of the economic and environmental constraints on coal production and use. Reprocessing could extend nuclear fuels for thousands of years. Neither coal nor nuclear alone can meet US needs during the transition to alternative energy sources, but together they can sustain the social and economic structure. Public controversy is only partly to blame for utilities not meeting their commitment to nuclear power. Also at fault are the lack of government support, siting and licensing uncertainties, opposition to the breeder reactor and reprocessing, and public concern about safety and waste management. An aggressive national policy needs to put all of these issues into perspective. (DCK)

11024 **(DOE/OR/20769—T2) Iowa state information handbook: formerly utilized sites remedial action program.** (Politech Corp., Washington, DC (USA)). 9 Feb 1981. Contract AC05-80OR20769. 109p. NTIS, PC A06/MF A01.

This volume is one of a series produced under contract with the DOE, By Politech Corporation to develop a legislative and regulatory data base to assist the FUSRAP management in addressing the institutional and socioeconomic issues involved in carrying out the Formerly Utilized Sites Remedial Action Program. This Information Handbook series contains information about all relevant government agencies at the Federal and state levels, the pertinent programs they administer, each affected state legislature, and current Federal and state legislative and regulatory initiatives. This volume is a compilation of information about the state of Iowa. It contains: a description of the state executive branch structure; a summary of relevant state statutes and regulations; a description of the structure of the state legislature, identification of the officers and committee chairmen, and a summary of recent relevant legislative action; the full test of relevant statutes and regulations.

11025 **(DOE/OR/20769—T3) Ohio state information handbook: formerly utilized sites remedial action program.** (Politech Corp., Washington, DC (USA)). 9 Feb 1981. Contract AC05-80OR20769. 88p. NTIS, PC A05/MF A01.

This volume is one of a series produced under contract with the DOE, by POLITECH CORPORATION to develop a legislative and regulatory data base to assist the FUSRAP management in addressing the institutional and socioeconomic issues involved in carrying out the Formerly Utilized Sites Remedial Action Program. This Information Handbook series contains information about all relevant government agencies at the Federal and state levels, the pertinent programs they administer, each affected state legislature, and current Federal and state legislative and regulatory initiatives. This volume is a compilation of information about the state of Ohio. It contains: a description of the state executive branch structure; a summary of relevant state statutes and regulations; a description of the structure of the state legislature, identification of the officers and committee chairmen, and a summary of recent relevant legislative action; the full test of relevant statutes and regulations.

11026 **(DOE/OR/20769—T4) Massachusetts state information handbook: formerly utilized sites remedial action program.** (Politech Corp., Washington, DC (USA)). 9 Feb 1981. Contract AC05-80OR20769. 102p. NTIS, PC A06/MF A01.

This volume is one of a series produced under contract with the DOE, by Politech Corporation to develop a legislative and regulatory data base to assist the FUSRAP management in addressing the institutional and socioeconomic issues involved in carrying out the Formerly Utilized Sites Remedial Action Program. This Information Handbook series contains information about all relevant government agencies at the Federal and state levels, the pertinent programs they administer, each affected state legislature, and current Federal and state legislative and regulatory initiatives. This volume is a compilation of information about the state of Massachusetts. It contains: a description of the state executive branch structure; a summary of relevant state statutes and regulations; a description of the structure of the state legislature, identification of the officers and committee chairmen, and a summary of recent relevant legislative action; the full text of relevant statutes and regulations.

11027 **(DOE/OR/20769—T5) California state information handbook: formerly utilized sites remedial action program.** (Politech Corp., Washington, DC (USA)). 9 Feb 1981. Contract AC05-80OR20769. 163p. NTIS, PC A08/MF A01.

This volume is one of a series produced under contract with the DOE, by Politech Corporation to develop a legislative and regulatory data base to assist the FUSRAP management in addressing the institutional and socioeconomic issues involved in carrying out the Formerly Utilized Sites Remedial Action Program. This Information Handbook series contains information about all relevant government agencies at the Federal and state levels, the pertinent programs they administer, each affected state legislature, and current Federal and state legislative and regulatory initiatives. This volume is a compilation of information about the state of California. It contains: a description of the state executive branch structure; a summary of relevant state statutes and regulations; a description of the structure of the state legislature, identification of the officers and committee chairmen, and a summary of recent relevant legislative action; the full text of relevant statutes and regulations.

11028 **(DOE/OR/20769—T6) Oregon state information handbook formerly utilized sites remedial action program.** (Politech Corp., Washington, DC (USA)). 31 Dec 1980. Contract AC05-800R20769. 171p. NTIS, PC A08/MF A01.

This volume is one of a series produced under contract with the DOE, by Politech Corporation to develop a legislative and regulatory data base to assist the FUSRAP management in addressing the institutional and socioeconomic issues involved in carrying out the Formerly Utilized Sites Remedial Action Program. This Information Handbook series contains information about all relevant government agencies at the Federal and state levels, the pertinent programs they administater, each affected state legislature, and current Federal and state legislative and regulatory initiatives. This volume is a compilation of information about the State of Oregon. It contains: a description of the state executive branch structure; a summary of relevant state statutes and regulations; a description of the structure of the state legislature, identification of the officers and committee chairmen, and a summary of recent relevant legislative action; and the full text of relevant statutes and regulations.

11029 **(DOE/OR/20769—T7) Pennsylvania state information handbook formerly utilized sites remedial action program.** (Politech Corp., Washington, DC (USA)). 31 Dec 1980. Contract AC05-800R20769. 178p. NTIS, PC A09/MF A01.

Portions of document are illegible.

This volume is one of a series produced under contract with the DOE, by Politech Corporation to develop a legislative and regulatory data base to assist the FUSRAP management in addressing the institutional and socioeconomic issues involved in carrying out the Formerly Utilized Sites Remedial Action Program. This Information Handbook series contains information about all relevant government agencies at the Federal and state levels, the pertinent programs they administer, each affected state legislature, and current Federal and state legislative and regulatory initiatives. This volume is a compilation of information about the State of Pennsylvania. It contains: a description of the state executive branch structure; a summary of relevant state statutes and regulations; a description of the structure of the state legislature, identification of the officers and committee chairmen, and a summary of recent relevant legislative action; and the full text of relevant statutes and regulations.

11030 **(DOE/OR/20769—T8) New York state information handbook formerly utilized sites remedial action program.** (Politech Corp., Washington, DC (USA)). 31 Dec 1980. Contract AC05-800R20769. 177p. NTIS, PC A09/MF A01.

This volume is one of a series produced under contract with the DOE, by Politech Corporation to develop a legislative and regulatory data base to assist the FUSRAP management in addressing the institutional and socioeconomic issues involved in carrying our the Formerly Utilized Sites Remedial Action Program. This Information Handbook series contains information about all relevant government agencies at the Federal and state levels, the pertinent programs they administer, each affected state legislature, and current Federal and state legislative and regulatory initiatives. This volume is a compilation of information about the State of New York. It contains: a description of the state executive branch structure; a summary of relevant state statutes and regulations; a description of the structure of the state legislature, identification of the officers and committee chairmen, and a summary of recent relevant legislative action; and the full text of relevant statutes and regulations.

11031 **(DOE/OR/20769—T9) New Mexico state information handbook formerly utilized sites remedial action program.** (Politech Corp., Washington, DC (USA)). 31 Dec 1980. Contract AC05-800R20769. 214p. NTIS, PC A10/MF A01.

This volume is one of a series produced under contract with the DOE, by Politech Corporation to develop a legislative and regulatory data base to assist the FUSRAP management in addressing the institutional and socioeconomic issues involved in carrying out the Formerly Utilized Sites Remedial Action Program. This Informaion Handbook series contains information about all relevant government agencies at the Federal and state levels, the pertinent programs they administer, each affected state legislature, and current Federal and state legislative and regulatory initiatives. This volume is a compilation of information about the State of New Mexico. It contains: a description of the state executive branch structure; a summary of relevant state statutes and regulations; a description of the structure of the state legislature, identification of the officers and committee chairmen, and a summary of recent relevant legislative action; and the full text of relevant statutes and regulations.

11032 **(DOE/OR/20769—T10) Missouri state information handbook formerly utilized sites remedial action program.** (Politech Corp., Washington, DC (USA)). 31 Dec 1980. Contract AC05-800R20769. 291p. NTIS, PC A13/MF A01.

Portions of document are illegible.

This volume is one of a series produced under contract with the DOE, by Politech Corporation to develop a legislative and rgulatory data base to assist the FUSRAP management in addressing the institutional and socioeconomic issues involved in carrying out the Formerly Utilized Sites Remedial Action Program. This Information Handbook series contains information about all relevant government agencies at the Federal and state levels, the pertinent programs they administer, each affected state legislature, and current Federal and state legislative and regulatory initiatives. This volume is a compilation of information about the State of Missouri. It contains: a description of the state executive branch structure; a summary of relevant state statutes and regulations; a description of the structure of the state legislature, identification of the officers and committee chairmen, and a summary of recent relevant legislative action; a description of the organization and structure of local governments affected by remedial action at the St. Louis area sites; a summary of relevant local ordinances and regulations; an identification of relevant public interest groups; a list of radio stations, television stations and newspapers that provide public information to the St. Louis area or to Jefferson City; and the full text of relevant statutes and regulations.

11033 **(DOE/OR/20769—T11) Federal government information handbook formerly utilized sites remedial action program.** (Politech Corp., Washington, DC (USA)). 31 Dec 1980. Contract AC05-800R20769. 92p. NTIS, PC A05/MF A01.

This volume is one of a series produced under contract with the DOE, by Politech Corporation to develop a legislative and regulatory data base to assist the FUSRAP management in addressing the institutional and socioeconomic issues involved in carrying out the Formerly Utilized Sites Remedial Action Program. This Information Handbook series contains information about all relevant government agencies at the Federal and state levels, the pertinent programs they administer, each affected state legislature, and current Federal and state legislative and regulatory initiatives. This volume is a compilation of information about the Federal Government. It contains: a summary of the organization and responsibilities of agencies within the executive branch of the Federal government which may be relevant to FUSRAP activities; a brief summary of relevant Federal statutes and regulations; a description of the structure of the US Congress, identification of the officers, relevant committees and committee chairmen; a description of the Federal legislative process; a summary of legislation enacted and considered in the recently-adjourned 96th Congress; a description of the Federal budgetary process; a summary of the Carter Administration's comprehensive radioactive waste management program; and excerpts from the text of relevant Federal statutes and regulations.

11034 **(KFK—2964) Review of empirical results concerning the problem of acceptance of nuclear power.** Beker, G.; van Berg, I.; Coenen, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse). May 1980. 190p. (In German). NTIS (US Sales Only), PC A09/MF A01.

In this report, the results of empirical surveys are presented which can contribute to the explanation of the problem of public acceptance of nuclear power. Main emphasis is laid on hypotheses about the factors underlying the nuclear power controversy formulated in scientific literature and political discussions. The appendix to the report contains a documentation of the empirical surveys considered, giving informations on sample, method, and main results.

11035 **Why California cannot afford to forego the nuclear option.** Miner, R. pp Paper 34, 18p of Energy: the new rules. Newman, D.T. (ed.). Santa Monica, CA; Management Education Corporation (1979).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

A summary of the author's present views of the future power demand-supply dilemma facing California in the critical 1985 to 1995 time frame is given. The nature of the demand uncertainty in that time frame which must be contended with now is described and why the author believes the state's current plans do not provide assurance that the electricity supply needs in the 1980's will be satisfied is explained. Analysis methods used are considered to be adequate to predict that several additional nuclear power plants should be on-line by 1990, or earlier if possible. This action would provide reasonable certainty that future power demands can be met.

2907 Transport And Storage

REFER ALSO TO CITATION(S) 10957, 11238, 11259

11036 **(AD-A—086573) Spatial variations in energy accessibility in the Soviet Union, 1960-1975. Final report.** Olson, R.V. Jr. (Army Military Personnel Center, Alexandria, VA (USA)). 19 Jun 1980. 143p. NTIS, PC A07/MF A01.

The emphasis in coal, oil, and natural gas production in the Soviet Union shifted dramatically eastward after 1960, but spatial patterns of energy accessibility remained fairly stable from 1960 to 1975. Utilizing annual coal, oil, and natural gas production data expressed in terms of standard fuel units and distances measured along railroad and pipeline routes, an energy potential model permitted the computation of energy potential indices based on distance and distance modified by generalized transport costs for 129 major administrative and industrial centers for 1960, 1970, and 1975. A general purpose contouring program mapped relative energy potential indices, and these maps showed that the areas with the highest energy accessibility were also among the most important industrial areas. A correlation analysis between energy accessibility and urban population growth revealed that changes in energy accessibility have had a modest influence on urban population growth rates. Soviet industrial location and urban population growth have been relatively unrestrained by the location of energy resources.

2910 Conservation

REFER ALSO TO CITATION(S) 10189, 10319, 11021, 11043, 11044, 11090, 11142, 11143, 11147, 11148, 11170, 11182, 11195

11037 (CONF-8009108—, pp 57-68) **Economics of energy sources and government-industry interaction.** Stelson, T. 1980.

From Alternate sources of energy conference; New York, NY, USA (29 Sep 1980).

A brief examination is made of the reasons for the reduction in the imports of oil in the US. It is pointed out that it is due largely to development of programs or understanding and opportunities, especially in solar energy and conservation. In these areas, capital is invested and operating expenses (fuels expenditures) are reduced. The potential of wind power is mentioned. The potential of alcohol fuels and production costs are briefly discussed. (MCW)

11038 **(EMD—80-97) Delays and uncertain energy savings in program to promote state energy conservation.** Staats, E.B. (General Accounting Office, Washington, DC (USA)). 2 Sep 1980. 83p. General Accounting Office, Washington, DC.

Report to the Congress by the Comptroller General of the United States.

The goal of the State Energy Conservation Program was to reduce the energy consumption of each state by about 5% by 1980. However, GAO does not believe that the 1980 goal have been attained or that the savings reported for 1978 are a valid measure of the program's impact on energy use. Before the program can reach its potential, the Department of Energy needs to: reevaluate the program's progress to establish goals and milestones that are more realistic and attainable; assure that estimated and actual energy savings are reported on a consistent and adequately supported basis; and improve program financial and progress reporting and monitoring. This second GAO annual report on the State Energy Conservation Program, covering activities through 1978 as the conditions existed at that time, addresses four aspects of the program: program effectiveness, energy savings, financial controls, and compliance monitoring.

11039 **(PB—80-186463) Energy conservation: a program for state and local governments. Executive summary.** (Public Technology, Inc., Washington, DC (USA)). 1979. 7p. NTIS, PC A02/MF A01.

This presentation outlines an energy program for state and local governments. While alternative sources of energy are being developed, energy conservation is the only way to meet the nation's short term needs. Ways to conserve present energy supplies involve lessening consumption by (1) reducing the use of energy demanding equipment or practices, (2) increasing the efficiency of energy demanding equipment, and (3) switching to alternate energy sources.

2920 Supply, Demand, And Forecasting

11040 **(AD-A—087083) Energy self-sufficiency for Air Force Logistics Command (AFLC) bases: an initial investigation. Master's thesis.** Hatch, C.R.; Mansfield, R.E. Jr. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Systems and Logistics). Jun 1980. 344p. NTIS, PC A15/MF A01.

To obtain Energy Self-Sufficiency for Air Logistics Centers by the year 2000, has been a stated goal since 1978. The purpose of this thesis was to develop a working definition of Energy Self-Sufficiency; to develop a statistical model for forecasting aggregate energy demand for the Air Logistics Centers; and to research some possible unconventional technologies which may assist in attaining the Energy Self-Sufficiency goal. This research revealed that the goal is rather limited and should be attainable based on the definition provided; aggregate energy demand for the Air Logistics Centers can be predicted by estimating heating and cooling degree days; and waste to energy conversion processes and solar technologies offer some potential for attaining the overall goal.

11041 **(AD-A—087088) A study of fuel supplies for emergency power generation at air logistics centers. Master's thesis.** Mott, S.J.; Nelson, S.D. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Systems and Logistics). Jun 1980. 174p. NTIS, PC A08/MF A01.

The uncertainty of the availability of future supplies of petroleum has raised the possibility that a future electrical power curtailment could be accompanied by a simultaneous curtailment of petroleum fuel supplies. During such curtailments the ability of the Air Force Logistics Command's Air Logistics Centers to accomplish the essential operations required by a wartime scenario may depend upon the use of emergency back-up generators to provide electrical power to critical facilities. After obtaining information about the back-up generators at each Air Logistics Center and the quantities of fuel likely to be available for generator use during a supply curtailment, a linear programming computer package is used to determine the maximum length of time each Air Logistics Center can continue to meet its minimum critical operating requirements during a complete curtailment of commercially supplied electrical power and petroleum fuels. After reviewing the results of the computer analyses, the authors conclude that a long-term curtailment may have significant adverse impact on the ability of the Air Logistics Centers to meet critical operating requirements during a war-time scenario.

11042 (CONF-800780—(Vol.1), pp 9-14) **Keynote commentary.** Patton, F.S. (Union Carbide Corp., Oak Ridge, TN). 23 Jul 1980.

From 46. National Society of Professional Engineers annual meeting; Detroit, MI, USA (20 Jul 1980).

The effect of cheap oil on the level of development and consumption reflects its wider range of applications, its higher energy content, and its lower pollutants than other fuels. The demand for cheap oil by the US and other western countries since 1950 outpaced their ability to develop domestic resources and led to a vast international trade in natural resources and commodities. Oil-fueled technology, goods, and food production made an unprecedented population growth possible that now coincides with a no-growth period of world oil and food production. Unless the First World exercises conservation and develops new energy technologies, there will not be either enough or affordable fuel for the Third World. (DCK)

11043 **(CONF-801213—(Prelim.)) Local alternative energy futures: developing economies/building communities.** Totten, M.; Glass, B.; Freedberg, M.; Webb, L. (Conference on Alternative State and Local Policies, Washington, DC (USA)). Dec 1980. Contract FG01-80CS10083. 427p. NTIS, PC A19/MF A01.

From Local alternative energy futures-developing economy building communities conference; Austin, TX, USA (11 Dec 1980). Portions of document are illegible.

A separate abstract was prepared for each of the three parts of the conference. A sufficient range of information is presented to enable interested parties to explore the viable alternatives for community self-sufficiency. The parts are entitled: Financial Incentives and Funding Sources; Standards, Regulations, Mandates, Ordinances, Covenants; and Community/Economic Development. (MCW)

11044 (CONF-801213—(Prelim.), pp 3-220) **Part one: financing alternative resources.** Dec 1980.

From Local alternative energy futures-developing economy building communities conference; Austin, TX, USA (11 Dec 1980).

A general perspective on financing alternative resources in a community is initially presented. Some areas covered dealing with local financing and funding options include municipal securities, commercializing solar energy through municipal solar utilities, models of municipal solar utilities, and a tax credit (solar) example (Harford County, Maryland). Oregon energy loan and solar bond programs; Maine, Massachusetts, and New Jersey state bond issues, California's funding programs for alternative energy; fossil fuels fund; attack on Western coal taxes; state taxation of Windfall Profits; energy conservation tax breaks; a 95% solar tax credit in California; major Federally-funded state-operated programs (energy conservation); and updates on the states' legislation dealing with state financing and funding options are covered in materials presented. Presentations dealing with Federal funding programs include: a Federal conservation and renewable energy resource directory; Environmental Study Conference guides to Federal energy conservation assistance and solar energy programs; updates on Federal funding programs; HUD documents and programs; Federal assistance for alcohol fuels development; and legislation concerning energy, windfall profits, and energy management partnerships. Financing for alternative resources relating to utilities includes information on solar energy and energy efficiency programs. DOE's utility programs; conservation loans in Arkansas; information on solar energy programs in California and at TVA; specific home energy loans in Seattle; and additional citations. Information on innovative sources is presented for small businesses, cooperatives, corporations, and reinvestment opportunities. Seven papers that discuss institutional lenders focus on energy conservation and solar energy. (MCW)

11045 (CONF-801213—(Prelim.), pp 221-333) **Part 2: standards, regulations, mandates, and ordinances, covenants.** Dec 1980.

From Local alternative energy futures-developing economy building communities conference; Austin, TX, USA (11 Dec 1980).

Standards, regulations, and mandates are discussed with emphasis placed on solar energy utilization and implementing energy conservation. Energy self-sufficiency is discussed in presentations citing experiences in Davis and Santa Clara, California; Portland, Oregon; and Seattle, Washington. Regulatory actions geared to rental housing owners and Minnesota's 1978 law requiring energy-disclosure reports for prospective home buyers are described. Solar mandates and ordinances are discussed with emphasis on local leadership. Legal aspects of appropriate technology, covenants (reading sources), and additional information dealing with consumer protection are presented. Building Energy Performance Standards, state options for lighting, energy-efficient procurement in state and local government, and profits from appliance energy standards are covered in a chapter on energy-efficiency standards. The Residential Conservation Service (RCS) is briefly described. Citizen group participation in public-utility regulation and cogeneration are briefly noted. Local energy initiatives include establishing information exchanges in other parts of the state. Input to the exchanges is requested. (MCW)

11046 **(DOE/CS/10047—T6) Role of local governments in promoting energy efficiency.** Lee, H. (Harvard Univ., Cambridge, MA (USA). Energy and Environmental Policy Center). Nov 1980. Contract AT01-79CS10047. 69p. NTIS, PC A04/MF A01.

An examination is made of the incentives which influence the decisions by local governments to adopt energy-efficiency programs, either unilaterally or in partnership with the Federal government. It is found that there is significant potential for improved energy efficiency in urban residential, commercial, and industrial buildings and that exploiting these opportunities is in the interest of both Federal and local governments. Unless there is a unique combination of strong local leadership, a tradition of resource management, and external energy shocks, communities are unlikely to realize this potential. Conflicting demands, traditional perceptions, and lack of funding pose a major barrier to a strong unilateral commitment by local governments. A Federal-local partnership built upon and complementary to existing efforts in areas such as housing, social welfare, and economic development offers an excellent opportunity to realize the inherent potential of local energy-efficiency programs. At the local level, energy is not perceived as an isolated issue, but one which is part of a number of problems arising from the continuing increase in energy prices.

11047 **(EPRI-EA—1633) Integration methodology for energy supplies and demands. Final report.** Thompson, R.G.; Stone, J.C.; Muthukrishnan, S. (Research for Growth and Transfer, Inc., Houston, TX (USA)). Nov 1980. 84p. NTIS, PC A05/MF A01.

A clear, workable methodology for integrating separate models of energy supplies and demands into a coherent market-equilibrating system is developed. The objective is to obtain a relatively simple system that can be readily disseminated and used extensively (and inexpensively) to provide forecasts and analysis of future movements in energy prices and quantities. The integration method is built heavily on the long-standing economic principles of price theory, blending knowledge of future options and past decisions into conventional supply/demand equations. Operationally, complex models of primary energy supply, energy conversion, and final demand are employed to generate a body of data on energy prices and quantities. Regression techniques are then employed to fit continuously smooth supply-and-demand functions to the generated data. These fitted equations summarize the economic and technical relationships embodied in the complex models. The resulting supply/demand equations are integrated into a workable equilibrium system for determining market-clearing prices and quantities. Several solutions of the integrated supply/demand system are computed as an illustration of potential uses of the (end result of the) methodology. Possible extensions and improvements of the methodology are briefly discussed.

11048 **(UCID—18856) US energy consumption and supply.** VanAtta, C.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Jan 1981. Contract W-7405-ENG-48. 44p. NTIS, PC A03/MF A01.

Energy consumption and cost in 1978 and 1979 are discussed with emphasis on the effect of imported oil on the economy of the United States. Some of the international aspects of energy supply are described, and actions to meet the probability of a cutoff of oil imports from the Persian Gulf area are suggested. Short- and long-range strategies for ensuring energy self-sufficiency are discussed. A rationale for major, long-range dependence on fission and fusion power is given, and the possible advantages of a nearly all-electric energy system are mentioned. Projection of energy consumption and supply to the year 2020 based upon economic and demographic models is discussed.

11049 **Where we go from here.** Morris, W.K. pp Paper 41, 539-562 of Energy: the new rules. Newman, D.T. (ed.). Santa Monica, CA; Management Education Corporation (1979).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

The petroleum industry must communicate as effectively as possible with those who are apparently content with the status quo in energy. The industry sees danger in the present energy situation. Dependency on foreign oil must be reduced and any answer to the question, Where do we go from here has to address this problem. The issues at stake for the petroleum industry are reviewed. Some of Standard Oil Company of California efforts to promote a climate more favorable to productive energy policies are described. The view that lawmakers, by and large, are just as interested in what they are hearing from constituents and organizations at home as they are in the abstract merits of issues is noted.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 10626, 11000, 11010, 11017, 11028, 11029, 11030, 11031, 11032, 11033, 11038, 11043, 11045, 11061, 11071, 11079, 11139, 11141, 11147, 11148, 11173, 11194

11050 **(DOE/EV/73002—1(Vol.3)) Alaska Regional Energy Resources Planning Project. Phase 2: coal, hydroelectric and energy alternatives. Volume III. Alaska's alternative energies and regional assessment inventory update.** Rutledge, G.; Lane, D.; Edblom, G. (Alaska State Div. of Energy and Power Development, Anchorage (USA)). 1980. Contract AT06-77EV73002. 300p. (DEPD—81-001-3(Vol.3)). NTIS, PC A13/MF A01.

Eight chapters are included. A separate abstract was included for each one. (MHR)

11051 (DOE/EV/73002—1(Vol.3), pp 20.1-20.10) **Regional assessment inventory update: Part 4. Identification and assessment programs.** 1980.

In Alaska Regional Energy Resources Planning Project. Phase 2: coal, hydroelectric and energy alternatives. Volume III. Alaska's alternative energies and regional assessment inventory update.

Descriptions of the programs of eleven agencies and organizations responding to a letter of inquiry are presented. The agencies and organizations are responsible for conducting surveys or inventory activities relating to oil, natural gas, coal, hydropower, uranium, geothermal, wind, and wood resources. (MHR)

11052 **(DOE/IR—0064) Managing Intergovernmental Affairs: new directions.** (USDOE Office of Intergovernmental Affairs, Washington, DC). 1980. 88p. Department of Energy, Office of Intergovernmental Affairs, Washington, DC.

The three Divisions (Program Planning and Development, Operations, and Special Projects) of the Office of Intergovernmental Affairs (IR) and their programs and systems are described. Part One discusses organizing, managing, and staffing. Part Two summarizes the functions of the ten Federal regions. Information on state energy powers and relations with national associations and the Office of IR is presented in Part Three. Local energy management and Indian energy development are covered in the next parts. Territorial energy independence is discussed in Part Six, while the Secretary's Intergovernmental Affairs Council is described in Part Seven. The mission of the Division of Special projects is described and the outlook for 1981 is forecast in the last two parts.

11053 **(EMD—80-86) Foreign tax credit and US energy policy.** Staats, E.B. (General Accounting Office, Washington, DC (USA)). 10 Sep 1980. 69p. General Accounting Office, 441 G St., NW, Washington, DC.

Report to the Congress of the United States by the Comptroller General.

The foreign tax credit is not an effective tool for shaping US energy policy. GAO reached this conclusion after examining whether the tax credit hinders, promotes, or does not affect the goals of reducing US oil imports and diversifying the sources of imported oil. Eliminating or severely curtailing the foreign tax credit would increase the effective rate of taxation on US oil companies operating abroad, and thereby may reduce the competitive stance of US companies' foreign operations. It could possibly reduce exploration and development efforts somewhat. However, the magnitude of these potential effects does not appear to be great enough to substantially reduce the ability of US companies to operate abroad or to fundamentally change the locus of oil-company activity overseas. Therefore, any change in the foreign tax credit should be based on tax rather than energy-policy objectives.

11054 **Organization and evaluation of the Texas Energy Extension Service.** Riter, S. (Texas A and M Univ, College Station). *Energy Communications ;* **6**: No. 1, 41-51(1980).

The Texas Energy Extension Service (EES) is one of ten pilot programs funded by the United States Department of Energy to test methods for transferring energy-related technologies and techniques to small energy users. This paper describes the organization and operation of the Texas EES and draws conclusions from the program of general interest to those involved in energy outreach activities. 2 refs.

11055 **Energy legislation and regulatory acts.** pp 565-863 of Energy: the new rules. Newman, D.T. (ed.). Santa Monica, CA; Management Education Corporation (1979).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

Texts of the five separate acts of the National Energy Act signed into law on November 9, 1978 are given as presented in Conference Reports. They are: Energy Tax Act of 1978 (Senate No. 95-1324); Powerplant and Industrial Fuel Use Act of 1978 (H.R. No. 95-1749); Public Utility Regulatory Policies Act of 1978 (H.R. No. 95-1750); National Energy Conservation Policy Act (H.R. No. 95-1751); and Natural Gas Policy Act of 1978 (H.R. No. 95-1752).

2940 Fossil Fuels

11056 (CONF-800334—(Vol.1), pp 147-154) **Coal combustion cleanup technology development.** Halow, J.S. (Dept. of Energy, Washington, DC). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

A comprehensive program to address the diverse environmental issues related to expanded coal utilization is being initiated as part of the DOE Advanced Environmental Control Technology program. Project activities ranging from studies of the fundamental processes involved in pollutant formation to demonstrations of well developed control methods are being supported. The program aim is to provide the needed cleanup technology to meet environmental constraints within a framework that considers costs, energy efficiency, and acceptability of the technology to the utility and industrial sectors.

11057 (CONF-800334—(Vol.1), pp 141-146) **Goals of the fossil energy Advanced Environmental Control Technology Program.** McCurdy, W.A. 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The Advanced Environmental Control Technology (AECT) Program is a new program within DOE which began in FY 1979. The Flue Gas Cleanup Project is a vital short term part of the AECT. Its purpose is the development, improvement, and technical and economic evaluation of existing and promising new methods for removing undesirable pollutants and wastes resulting from the combustion of coal. The project is directed toward conducting full-scale verification of equipment and systems that will reliably and economically provide solutions to environmental degradation associated with direct coal utilization. The objective is to provide technology to meet environmental regulations in the early- and mid-1980's considering reliability, costs, and energy efficiency.

11058 (CONF-800780—(Vol.1), pp 17-27) **Future of oil and gas: 1980 and beyond.** Bovay, H.E. Jr. (Bovay Engineers, Inc., Richland, WA). 23 Jul 1980.

From 46. National Society of Professional Engineers annual meeting; Detroit, MI, USA (20 Jul 1980).

The US must transform itself during the remainder of the century from a petroleum-based to an energy-diversified economy. US dependence on imports is expected to continue unless major changes occur in energy-supply and consumption patterns. Supply figures show that the US is not making oil and gas discoveries fast enough to keep up with consumption and that the years of world supply are very short. The outlook is especially bad for the developing countries. The consequences of oil-supply disruptions from political unrest and war in the Middle East are seen in the economic and diplomatic strains among oil-importing nations. Conservation and energy planning appear to be the only near-term solutions. These can focus on improving automobile efficiency and changing public attitudes toward saving. Immediate large-scale domestic energy production, including synthetic fuels, must not be deterred by uncertainties. 5 figures. 1 table. (DCK)

11059 (CONF-800780—(Vol.1), pp 33-49) **Future of coal: 1980 and beyond.** Funk, J.E. (Univ. of Kentucky, Lexington); Gates, L.C. 23 Jul 1980.

From 46. National Society of Professional Engineers annual meeting; Detroit, MI, USA (20 Jul 1980).

The US has 31% of the world's coal reserves - enough to meet its energy needs for 40 to 50 years and allow alternative fuels to follow an orderly research, development, and commercialization procedure. The US underuses its coal, however, relying on coal for only 19% of the energy consumed. Projections of energy supplies by fuel and demand by consuming sector will begin to deviate from the historical patterns that were distorted by government policies that encouraged the use of gas and oil. Coal and nuclear energy will assume a larger share of the energy mix for the rest of the century, especially for power generation. Since the price and availability of fuels will directly affect world stability, the need to expand coal use and develop synthetic fuels industries must lead to more-reasonable and fair environmental regulations, increased mine productivity, and a resolution of the problem of how to transport coal. 7 figures, 4 tables. (DCK)

11060 (CONF-8004110—, pp 237-243) **Scenario for atmospheric CO_2 to 2025.** Rotty, R.M.; Marland, G. (Oak Ridge Associated Universities, TN). Dec 1980.

From DOE research conference on CO/sub 2/; Washington, DC, USA (24 Apr 1980).

A comprehensive estimate of world fossil fuel resources available for eventual burning, plus a scenario for world energy demand to 2025 have been developed. The CO_2 release that would accompany this world demand scenario would produce an atmospheric CO_2 concentration of between 400 and 450 ppM in 2025 depending on the fraction retained by the atmosphere. The authors contend that rational demand scenarios can be developed in which the CO_2 increase is sufficiently small, along with the concomitant climate effect, that major decisions affecting the global energy supply system and the global economy are not likely to be based on CO_2 criteria over the next several decades. They do not dismiss CO_2 as a long-term concern, but believe that there is time to develop a better understanding of the science before CO_2 becomes an economic and energy decision criterion.

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 10417, 10425, 11262

11061 **(DOE/RA—0058/2) Alternative fuels production program. Semiannual report to the Congress of the United States.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Resource Applications). Nov 1980. 188p. NTIS, PC A09/MF A01.

This report describes the provisions of Public Law 96-126 and subsequent legislation enacted by Congress applicable to this program. It also describes the implementation approach and activities performed pursuant to this program, including: program strategy and objectives, organization established to execute the program, content and structure of the solicitations issued and proposal evaluation and selection process. The accomplishments achieved are presented, namely: awards made under the initial round of feasibility studies and cooperative agreements; the second round of solicitations issued for feasibility studies and cooperative agreements; the solicitations issued for financial assistance in the form of loan guarantees, price guarantees, and purchase commitments under the authority of the Federal Nonnuclear Research and Development Act, and under the Defense Production Act amendments contained in the Energy Security Act; and the dissemination of information achieved under the program's public outreach efforts. The report identifies the future actions and anticipated schedule for completion of the balance of the Alternative Fuels Production Program, including dates for the completion of the proposal review, selection, and award process.

11062 **What will power future non-highway transportation?.** *Automotive Engineering (New York) ;* **87**: No. 10, 82-87(Oct 1979).

Exxon researchers have completed a study for the Dept. of Energy to identify alternate fuels and prime movers which should be of most interest for each mode of non-highway transportation from the present to the year 2000 and beyond. Eighteen different alternative fuels were considered and represented by three different resource bases. Methane and hydrogen in both gaseous and liquified form were considered as well as electricity as an energy carrier. Initially, synthetic fuels are likely to be commingled with petroleum products since they may be refined in existing facilities. Engines used in non-highway transportation generally last 20 years or more and thus fuels similar to current products will be needed for the next 20 to 30 years.

11063 **DOE program on hydrogen energy systems: what's happening?.** Berger, B.J.; Swisher, J.H. (US DOE, Washington, DC). *Energy (Stamford, Connecticut) ;* **4**: No. 4, 29-30(1979).

The production of hydrogen requires more effort than the other areas of hydrogen technology at present, for two reasons. First, storage, transport, and conversion technologies will not be used if economic processes for hydrogen production are not developed. Second, some of the most-difficult technological problems are associated with hydrogen production. Energy sources and energy carriers available for hydrogen production include coal, electricity, nuclear process heat, and solar energy. Storage options include hydrides, liquid hydrogen, gaseous hydrogen in pressurized tanks, and storage in underground caverns. Hydrogen may be converted to electricity in fuel cells and turbines, or used directly as a chemical feedstock and multipurpose fuel. Use of existing gas pipelines will be important for hydrogen use and a strong program is developing to establish pipeline compatibility with hydrogen. Another key technological advance is the development of lightweight, low-cost hydrogen storage for vehicles, important if hydrogen is to have widespread use as a non-polluting vehicle fuel.

2960 Electric Power

11064 **(ANL/SPG—13(Vol.1)) Load research manual. Volume 1. Load research procedures.** (Argonne National Lab., IL (USA); National Economic Research Associates, New York (USA)). Nov 1980. Contract W-31-109-ENG-38. 108p. NTIS, PC A06/MF A01.

This three-volume manual presents technical guidelines for electric utility load research. Special attention is given to issues raised by the load data reporting requirements of the Public Utility Regulatory Policies Act of 1978 and to problems faced by smaller utilities that are initiating load research programs. In Volumes 1 and 2, procedures are suggested for determining data requirements for load research, establishing the size and customer composition of a load survey sample, selecting and using equipment to record customer electricity usage, processing data tapes from the recording equipment, and analyzing the data. Statistical techniques used in customer sampling are discussed in detail. The costs of load research also are estimated, and ongoing load research programs at three utilities are described. The manual includes guides to load research literature and glossaries of load research and statistical terms.

11065 **(ANL/SPG—13(Vol.2)) Load research manual. Volume 2. Fundamentals of implementing load research procedures.** (Argonne National Lab., IL (USA); National Economic Research Associates, New York (USA)). Nov 1980. Contract W-31-109-ENG-38. 218p. NTIS, PC A10/MF A01.

This three-volume manual presents technical guidelines for electric utility load research. Special attention is given to issues raised by the load data reporting requirements of the Public Utility Regulatory Policies Act of 1978 and to problems faced by smaller utilities that are initiating load research programs. In Volumes 1 and 2, procedures are suggested for determining data requirements for load research, establishing the size and customer composition of a load survey sample, selecting and using equipment to record customer electricity usage, processing data tapes from the recording equipment, and analyzing the data. Statistical techniques used in customer sampling are discussed in detail. The costs of load research also are estimated, and ongoing load research programs at three utilities are described. The manual includes guides to load re-

search literature and glossaries of load research and statistical terms.

11066 **(ANL/SPG—13(Vol.3)) Load research manual. Volume 3. Load research for advanced technologies.** (Argonne National Lab., IL (USA); Gordian Associates, Inc., New York (USA)). Nov 1980. Contract W-31-109-ENG-38. 75p. NTIS, PC A04/MF A01.

This three-volume manual presents technical guidelines for electric utility load research. Special attention is given to issues raised by the load data reporting requirements of the Public Utility Regulatory Policies Act of 1978 and to problems faced by smaller utilities that are initiating load research programs. The manual includes guides to load research literature and glossaries of load research and statistical terms. In Volume 3, special load research procedures are presented for solar, wind, and cogeneration technologies.

11067 **(BNL—28745) Electricity demand curtailment planning.** Allentuck, J.; Carroll, O.; Schnader, M. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). 1980. Contract AC02-76CH00016. 23p. (CONF-801126—2). NTIS, PC A02/MF A01.

From ORSA/TIMS joint national meeting; Colorado Springs, CO, USA (9 Nov 1980).

The state of electricity demand curtailment planning for long term electricity supply disruptions is reviewed. Legal, institutional and technological problems associated with demand curtailment plans are examined, and the existence of well defined social objectives on the part of planners is questioned. A linear programming approach to electricity demand curtailment planning is presented.

11068 **(BNL—28839) WASP and electricity capacity expansion planning for emerging countries.** Allentuck, J. (Brookhaven National Lab., Upton, NY (USA)). Nov 1980. Contract AC02-76CH00016. 16p. (CONF-801137—2). NTIS, PC A02/MF A01.

From Workshop on energy policy analysis; Urbino, Italy (3 Nov 1980).

The WIEN Automatic System Planning Package (WASP) is typical of electrical generation capacity expansion planning models in general use today. It was developed by the Tennessee Valley Authority (TVA) for the International Atomic Energy Agency (IAEA) hence the name WIEN. It is available without charge to member states. Assistance in its use is available from IAEA staff and in addition it is well documented. The user of WASP should be aware of its uses and limitations especially, though not exclusively, in its application to emerging countries. This paper presents an overview of capacity expansion planning and its place in the economic planning process with reference to the emerging countries; describes in a general way the use of WASP; cautions care in the interpretation of WASP results; and suggests the way in which WASP can be used to assess innovative electric generating technologies.

11069 **(BNL—51215) Survey review of models for use in market penetration analysis: utility sector focus.** Groncki, P.J.; Kydes, A.S.; Lamontagne, J.; Marcuse, W.; Vinjamuri, G. (Brookhaven National Lab., Upton, NY (USA)). Nov 1980. Contract AC02-76CH00016. 40p. NTIS, PC A03/MF A01.

The ultimate benefits of federal expenditures in research and development for new technologies are dependent upon the degree of acceptance of these technologies. Market penetration considerations are central to the problem of quantifying the potential benefits. These benefits are inputs to the selection process of projects competing for finite R and D funds. Market penetration is the gradual acceptance of a new commodity or technology. The Office of Coal utilization is concerned with the specialized area of market penetration of new electric power generation technologies for both replacement and new capacity. The common measure of market penetration is the fraction of the market serviced by the challenging technology for each time point considered. The methodologies for estimating market penetration are divided into three generic classes: integrated energy/economy modeling systems, utility capacity expansion models, and technology substitution models. In general, the integrated energy/economy modeling systems have three advantages: they provide internally consistent macro, energy-economy scenarios, they account for the effect of prices on demand by fuel form, and they explicitly capture the effects of population growth and the level and structure of economic activity on energy demand. A variety of deficiencies appear in most energy-economy systems models. All of the methodologies may be applied at some level to questions of market penetration of new technologies in the utility sector; choice of methods for a particular analysis must be conditioned by the scope of the analysis, data availability, and the relative cost of alternative analysis.

11070 **(DOE/EIA—0040(80)) Energy data report. Typical electric bills: January 1, 1980.** Byrdsong, B.D. (USDOE Energy Information Administration, Washington, DC. Office of Coal and Electric Power Statistics). Dec 1980. 222p. NTIS, PC A10/MF A01.

The cost to consumers for representative amounts of electricity used per month for residential, commercial, and industrial service in all sections of the US is reported. Bills for residential electric service are reported for five different energy consumption levels in all communities with populations of 2500 or larger. For commercial and industrial service, bills are presented for all large cities. Present long-term trends and current levels of average electric bills for Residential, Commercial, and Industrial Service are shown for the total United States, for each state and the District of Columbia, and for the nine Census Regions. The bills are calculated under the rate schedules generally applicable to the majority of customers taking service under the conditions and classes of service specified, although utilities may have other rate schedules available that produce different bills from those shown. No attempt is made to evaluate the many factors that produce differences in the level of bills.

11071 **(DOE/PE/70278—T1) Public utility regulation and national energy policy.** Navarro, P. (Harvard Univ., Cambridge, MA (USA). John Fitzgerald Kennedy School of Government). Sep 1980. Contract AC01-80PE70278. 34p. NTIS, PC A03/MF A01.

The linkage between Public Utility Commission (PUC) regulation, the deteriorating financial health of the electric utility industry, and implementation of national energy policy, particularly the reduction of foreign petroleum consumption in the utility sector is examined. The role of the Nation's utilities in the pursuit of national energy policy goals and postulates a linkage between PUC regulation, the poor financial health of the utility industry, and the current and prospective failure to displace foreign petroleum in the utility sector is discussed. A brief history of PUC regulation is provided. The concept of regulatory climate and how the financial community has developed a system of ranking regulatory climate in the various State jurisdictions are explained. The existing evidence on the hypothesis that the cost of capital to a utility increases and its availability is reduced as regulatory climate grows more unfavorable from an investor's point of view is analyzed. The implications of this cost of capital effect on the electric utilities and collaterally on national energy policy and electric ratepayers are explained. Finally various State, regional and Federal regulatory responses to problems associated with PUC regulation are examined.

11072 **(DOE/RA/20505—01) Evaluation of higher distribution and/or utilization voltages. Final report.** Hazelrigg, G.A. Jr. (ECON, Inc., Princeton, NJ (USA)). Jan 1981. Contract AC01-78ET20505. 41p. NTIS, PC A03/MF A01.

An electric energy distribution/utilization system cost analysis model is presented for exploring cost tradeoffs (capital innvestment, operation and maintenance and cost of losses) and optimizing system configuration. The model focuses on the treatment of residential and light commercial service areas with time-varying load characteristics, including customer load profile changes, per customer load growth and service area population growth. Applications of the model are discussed. These include providing insight on: the selection of primary and secondary voltages; conductor sizing; distribution transformer sizing, change out policies and copper-to-core-loss ratio; and limits on allowable voltage variation at the service entrance. Examples are provided to illustrate model capabilities.

11073 (DOE/RG/00335—02) Discussion series on PURPA related topics. Sturgeon, J.I. (City Utilities of Springfield, MO (USA)). Aug 1980. Contract 01-77ZZ00335. 106p. NTIS, PC A06/MF A01.

The US DOE sponsored 25 demonstration and implementation projects dealing with electric utility load management, metering, and billing. This volume deals with the procedures and equipment which are affected when time-of-usage (TOU) pricing is used as the basis for the billing process and with the reaction of customers to TOU billing. TOU billing required more equipment, special training for billing personnel, longer billing time, and up to twice the billing process cost as compared with traditional billing, but the time and cost factors should be reduced with experience. (LCL)

11074 (DOE/RG/00335—05) Discussion series on PURPA related topics. Sturgeon, J.I. (City Utilities of Springfield, MO (USA)). Aug 1980. Contract 01-77ZZ00335. 61p. NTIS, PC A04/MF A01.

The master metering of electricity was investigated in nine of the Pilot Implementation Projects. These studies showed that master metering increased the level of energy consumption by as much as 40% in some areas and 11% in others. One study of housing units before and after conversion to individual metering showed consumption reductions of 17 and 20%. Two costs of eliminating master metering other than the cost of meters were: the loss of centralized space conditioning and hot water systems and increased building costs. It was found that centralized space heating systems used 10 to 15% less energy than individual systems. In one Project it was estimated that construction costs in high rise buildings could increase by around $3,000 per apartment if master metering was eliminated. Five alternatives to eliminating master metering were examined or considered. Submetering was reviewed but the lack of reliable and economical submeters prevented its testing. Another alternative was to bill master metered customers on multiple block rates. This was used in one Project and it eliminated the cost advantage of master metering. Although alternatives to the elimination of master metering were examined most commission actions were directed at its elimination. Most commissions exempted specific uses such as centralized hot water and central heating and cooling systems. Typically the ban on master metering was for new construction.

11075 (EPRI-EA—1672(Vol.1)) Regional load curve models: specification and estimation of the DRI Model. Final report. Platt, H.D.; Einhorn, M.A.; Ignelzi, P.C.; Poirier, D.J. (Data Resources, Inc., Lexington, MA (USA)). Jan 1981. 240p. NTIS, PC A10/MF A01.

The DRI Model of hourly load curves is developed in this report. The model is capable of producing long-term forecasts for 32 US regions. These regions were created by aggregating hourly system load data from 146 electric utilities. These utilities supply approximately 95% of all electricity consumed in the continental US. The model forecasts electricity demands for each hour of the year for each of the 32 regions. Model output includes forecasts of peak demands, megawatt hour demands, load factors, and load duration curves. The DRI Model is estimated in two stages. In the first stage, for each region and month, hourly electricity demands are parameterized into load components representing the effects of lifestyles and weather on regional loads through a time-series model. In the second stage, the variation in these parameterized load components across months and regions is modeled econometrically in terms of energy prices, income levels, appliance saturation rates, and other variables. The second-stage models are essentially models of electricity demand which are estimated using estimated first-stage parameters as dependent variables, instead of observed demands. Regional price and income demand elasticities are implied by the second-stage models. Moreover, since the dependent variables refer to particular hours of the day, these estimated elasticities are hour-specific. (Since prices did not vary over the day in years when hourly load data were available, hour-to-hour, cross-price elasticities were not estimated.) Integrated system hourly load forecasts are obtained combining the influences of individual customer classes. Finally, approximate customer class hourly load shapes can be produced for each region, though these series may be useful only in research endeavors since they lack the precision available through survey methods.

11076 (ORNL/Sub—7662/1) Impact of dispersed solar and wind systems on electric distribution planning and operation. Boardman, R.W.; Patton, R.; Curtice, D.H. (Systems Control, Inc., Palo Alto, CA (USA)). Feb 1981. Contract W-7405-ENG-26. 189p. NTIS, PC A09/MF A01.

Small-scale dispersed solar photovoltaic and wind generation (DSW) will affect the generation, transmission, and distribution systems of an electric utility. This study examines the technical and economic impacts of dispersing DSW devices within the distribution system. Dispersed intermittent generation is included. Effects of DSW devices on capital investments, reliability, operating and maintenance costs, protection requirements, and communication and control requirements are examined. A DSW operation model is developed to help determine the dependable capacity of fluctuating solar photovoltaic and wind generation as part of the distribution planning process. Specific case studies using distribution system data and renewable resource data for Southern California Edison Company and Consumers Power Company are analyzed to gain insights into the effects of interconnecting DSW devices. The DSW devices were found to offer some distribution investment savings, depending on their availability during peak loads. For a summer-peaking utility, for example, dispersing photovoltaic systems is more likely to defer distribution capital investments than dispersing wind systems. Dispersing storage devices to increase DSW's dependable capacity for distribution systems needs is not economically attractive. Substation placement of DSW and storage devices is found to be more cost effective than feeder or customer placement. Examination of the effects of DSW on distribution system operation showed that small customer-owned DSW devices are not likely to disrupt present time-current distribution protection coordination. Present maintenance work procedures, are adequate to ensure workmen's safety. Regulating voltages within appropriate limits will become more complex with intermittent generation along the distribution feeders.

11077 (ORNL/Sub—7886/1) State regulation and power plant productivity: background and recommendations. (National Regulatory Research Inst., Columbus, OH (USA)). Sep 1980. Contract W-7405-ENG-26. 138p. NTIS, PC A07/MF A01.

This report was prepared by representatives of several state regulatory agencies. It is a guide to some of the activities currently under way in state agencies to promote increased availability of electrical generating power plants. Standard measures of plant performance are defined and the nature of data bases that report such measures is discussed. It includes reviews of current state, federal, and industry programs to enhance power plant productivity and provides detailed outlines of programs in effect in California, Illinois, Michigan, New York, North Carolina, Ohio, and Texas. A number of actions are presented that could be adopted by state regulatory agencies, depending on local conditions. They include: develop a commission position or policy statement to encourage productivity improvements by utilities; coordinate state efforts with ongoing industry and government programs to improve the acquisition of power plant performance data and the maintenance of quality information systems; acquire the capability to perform independent analyses of power plant productivity; direct the establishment of productivity improvement programs, including explicit performance objectives for both existing and planned power plants, and a performance program; establish a program of incentives to motivate productivity improvement activities; and participate in ongoing efforts at all levels and initiate new actions to promote productivity improvements.

11078 (PB—80-188261) A problem assessment of time-of-day electricity rate structures. Diffenbach, J.; Murphy, D.; Renda, A. (Boston Coll., Chestnut Hill, MA (USA). Graduate School of Management). Apr 1980. 190p. NTIS, PC A09/MF A01.

The study identifies the important longterm, indirect impact issues of time-of-day (TOD) pricing of electricity. It points out the potential for adverse societal consequences in the areas of electricity consumption, capital investment, decentralization of electricity generation, effect on solar energy, and night activity. A number of policy issues were identified dealing with mandatory vs. optional rates, strength of price signals, length of peak periods, revenue de-

termination, speed of implementation, waiver provisions for those subject to pricing disadvantages, policy variations for different classes of customers, and Federal vs. state regulation of TOD standards and rates. This assessment provides a synthesis of findings as well as quantitative analyses of specifics. As the integrating methodology for this study, influence diagrams were chosen. Influence diagrams represent the initial qualitative step toward a more rigorous, intensive investigation of the impact issues by means of systems dynamics methodology. The latter methodology is one of the recommended strategies for further study of these issues. Two supporting methodologies used in this report are limits analysis and the use of compatibility assessment for generating more plausible alternative contextual scenarios which could shape TOD pricing consequences.

11079 **Public power in the 1980s: the impact of energy legislation.** Radin, A. Washington, DC; Library, American Public Power Association (1980). 20p. (CONF-800264—5).

From 24. American Public Power Association annual engineering and operations workshop; Phoenix, AZ, USA (25 Feb 1980).

Measures that are currently pending in the Congress or before government agencies which could affect the way utilities are operated in the future are discussed. Measures discussed cover the following areas: utility energy conservation; building energy performance standards; utility oil reduction program; synfuels bill; hydroelectric power development; nuclear power; formation of a board to speed energy projects; deregulation of railroads and corresponding impacts; facilitating coal-slurry pipelines; and proposals for streamlining procedures. Revelations of energy policies by analysis of the national budget are noted. (MCW)

11080 **(UCRL—84162) Loss of load probability for systems of dependent transmission and generation components.** George, L.L.; Wells, J.E. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Jan 1981. Contract W-7405-ENG-48. 7p. (CONF-810414—1). NTIS, PC A02/MF A01.

From Reliabililty conference for the electric power industry; Portland, OR, USA (21 Apr 1981).

Capacity planning requires system loss of load probability (LOLP). Generating station capacities, transmission network configurations, and loads determine LOLP. Optical capacity planners compare the expected discounted cost of capacity with the expected discounted cost of loss of load. One factor in the latter cost is LOLP. How to compute it when generating station capacities and transmission network configurations are dependent on each other and on the loads is shown, as well as how to compute sensitivity of LOLP to capacities, loads, and transmission links. The LOLP computation represents dependent generating station capacities and loads as dependent multivariate normal or lognormal random variables or mixtures of them. The random variables may depend on the transmission network configuration which is also random. The LOLP is a sum of multivariate normal integrals multiplied by configuration probability. Each integral is the LOLP for a configuration. This representation of LOLP makes sensitivity analysis easy. Derivatives of LOLP with respect to capacity and load parameters and with respect to configuration probabilities indicate sensitivity of LOLP to generating station, capacities, loads, and transmission links. Inputs are the joint cumulative distribution functions (cdfs) of loads and capacities for all components, the network diagrams that define alternative generation and transmission configurations, and the probabilities of the configurations. The joint cdfs must be normal, lognormal, or mixtures of normal or lognormal cdfs. (Mixtures can fit multimodal cdfs or cdfs with positive probability on a set of measure zero.)

11081 **Current research affecting APPA members.** Balzhiser, R.E. Palo Alto, CA; Electric Power Research Institute (1980). 21p. (CONF-800264—12). Library, American Public Power Association, Washington, DC $3.00.

From 24. American Public Power Association annual engineering and operations workshop; Phoenix, AZ, USA (25 Feb 1980).

Some specific research and development programs underway at EPRI that may be of interest to APPA members are described. Progress is reported on programs to assess the feasibility of small advanced gas turbines for utilities; to evaluate the burning properties of alternative fuels in conventional diesel engines; to make available several hundred barrels of hydrogenerated shale oil for these diesel tests to be run during 1980; to develop a data base describing the existing utilization and operating data of diesel generators; to develop methods to improve the confidence of distribution-load forecasting; to prolong existing component life, develop suitable substitutes for components, control tree growth, and develop improved line hardware for overhead distribution lines; and to cover the neutral wires of underground cables with a proper jacket. Preparation of a handbook on cathodic protection based on field testing of underground cables is noted. Improvements of the cable plow are briefly discussed and programs utilizing municipal wastes by electric utilities are planned. EPRI's rate design study, performed over the last 2-3 years by NARUC and partially sponsored by APPA, is discussed briefly. (MCW)

11082 **Power plant permit process, a regulatory maze.** Ziegler, K. Bismarck, ND; Basin Electric Power Cooperative (1980). 25p. (CONF-800264—1). Library, American Public Power Association, Washington, DC.

From 24. American Public Power Association annual engineering and operations workshop; Phoenix, AZ, USA (25 Feb 1980).

The need for a congressional review of the regulatory maze which confronts electric utilities in the planning of new generating facilities is discussed with specific references to overlapping local, state, and federal regulations related to air, water, and noise pollution, land and water use, and general environmental protection. (LCL)

11083 **Water and waste disposal for new electric generating facilities.** Smith, H.L.; Randall, W.H. Jackson, MI; Gilbert/Commonwealth (1980). 27p. (CONF-800264—6). Library, American Public Power Association, Washington, DC $3.00.

From 24. American Public Power Association annual engineering and operations workshop; Phoenix, AZ, USA (25 Feb 1980).

A small segment of the very large array of regulations related to water and waste disposal which confronts the utility manager is discussed. (LCL)

11084 **Utility responsibility in the design and construction of coal-fired power plants.** Winter, J. Washington, DC; American Public Power Association (1980). 4p. (CONF-800264—10). Library, American Public Power Association, Washington, DC $3.00.

From 24. American Public Power Association annual engineering and operations workshop; Phoenix, AZ, USA (25 Feb 1980).

The experience of the City of Gainesville, Florida electric utility in using an A/E firm to design and oversee the construction of a cool-fired power plant and in arranging for coal deliveries and plant operation is discussed. (LCL)

11085 **Economics of advanced generation concepts for locally-owned utilities.** Steitz, P. Kansas City, MO; Burns and McDonnell (1980). 39p. (CONF-800264—7). Library, American Public Power Association, Washington, DC $3.00.

From 24. American Public Power Association annual engineering and operations workshop; Phoenix, AZ, USA (25 Feb 1980).

Economic studies of advanced power generating concepts, including fuel cells, organic Rankine bottoming cycle, and solar thermal power plants, which aimed at identifying cost and performance targets that would have to be met in order for these concepts to be evaluated for locally-owned utility use are reviewed, and the implications of the results of these studies for such utilities are discussed. (LCL)

11086 **California energy supply outlook: grim.** Miner, R. pp Paper 2, 117-144 of Energy: the new rules. Newman, D.T. (ed.). Santa Monica, CA; Management Education Corporation (1979).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

Statewide Commission demand data for 1975 and 1985 are briefly examined, including the effects of conservation. The status of the key planned plants in California for the 1980's and some of the problems facing each of the plants are reported. It is concluded that the outlook appears grim. (MCW)

11087 **Impact of current environmental legislation on the electric utility industry.** Mason, P.F. (Bechtel Power Corp., San Francisco, CA). pp Paper 36, 463-488 of Energy: the new rules. Newman, D.T. (ed.). Santa Monica, CA; Management Education Corporation (1979).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

Recent legislation at the Federal and state levels of government relating to air, water, waste products, energy, and fuel use has had a number of effects on the electric utility industry. Some of the near-term effects relate to the imposition of more air and water cleanup systems to meet environmental goals and objectives. Some of the long term implications relate to the ways in which the electric utility industry must carry out its business. A summary of some of the current changes in environmental legislation is presented and the types of impact this legislation is having and is expected to have on the electric utility industry are described. Environmental legislation includes the Clear Air Act; Clean Water Act; Resource Conservation and Recovery Act; Toxic Substances Control Act; and Power Plant and Industrial Fuel Use Act.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 11008, 11048, 11173

11088 **(UCRL—52907) Judgmental estimate of energy consumption for the next 40 years (1980 to 2020).** Higgins, G.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Apr 1980. Contract W-7405-ENG-48. 24p. NTIS, PC A02/MF A01.

Projections for US energy consumption for the next 40 years are presented. The projections assume that US citizens will respond interactively in their best interest when it becomes clear what that interest is - for example, that individuals on their own initiative will insulate their homes when heating fuels become more costly, especially if insulation becomes relatively cheaper or easier to finance. Otherwise, the projections resemble those used in other forecasts. The difference lies in the result. If one takes into account people and their likely responses, the forecast suggest that, by the year 2000, we should be able to reduce our present liquid fuel consumption by 50% and nearly eliminate oil imports. Five sectors were studied: residential, commercial, industrial, transportation, and nonfuel.

11089 **Descriptive documentation for New Mexico electricity econometric final demand model.** Baxter, J.D.; Ben-David, S. Sante Fe, NM; EMIS, Resource and Development Div., State of New Mexico (1981). 19p. (NP—25230).

A mathematical model is developed for computing consumption and residential electric power demands for New Mexico. Factors considered in developing the model included: number of electric utility customers, past consumption data; household devices using electric power and their energy efficiencies; climatic conditions; and power costs. (LCL)

2990 Unconventional Sources And Power Generation

11090 **(AD-A—086196) Pacific Missile Test Center energy projects. Summary of projects, contributions, and plans. Technical publication.** Rosenthal, J.; Savant, C. (Pacific Missile Range, Point Mugu, CA (USA)). Jan 1980. 52p. NTIS, PC A04/MF A01.

This report is a compilation of the projects undertaken at the Pacific Missile Test Center to conserve energy, develop and apply alternative energy sources, and develop, in the 1980s, basic capability (BACADE) projects for applying energy-saving technology to the needs of the Pacific Missile Test Center.

11091 **(CONF-800780—(Vol.1), pp 69-128) Overview of solar-energy technologies: heating, photovoltaics, wind, and biomass.** Stout, B.A. (Michigan State Univ., East Lansing); Clark, J.A.; Maycock, P.; Asmussen, J. 23 Jul 1980.

From 46. National Society of Professional Engineers annual meeting; Detroit, MI, USA (20 Jul 1980).

Solar energy is a technically and environmentally feasible alternative to fossil fuels. An overview of four solar technologies and their costs covers space and water heating, photovoltaics, wind, and biomass. A life-cycle model of solar-space-heating systems considers four specific types of investment possibilities. A TI-59 programmable calculator analyzes the economics of solar-water-heating systems. Solar heating and cooling could contribute 5.6 quads per year by 2000. Another quad could come from photovoltaics if the price of solar cell modules is reduced enough, while DOE estimates the wind potential at 1.7 and biomass at 5.5 quads. The discussion for each technology includes a technical and economic assessment and the potential for application. (DCK)

11092 **(DOE/EV/73002—1(Vol.3), pp 17.1-17.10) Siting criteria and preliminary screening of communities for alternate energy use.** 1980.

In Alaska Regional Energy Resources Planning Project. Phase 2: coal, hydroelectric and energy alternatives. Volume III. Alaska's alternative energies and regional assessment inventory update.

Siting criteria are discussed for wind power, hydroelectric power, geothermal energy, and fuel cells. A preliminary evaluation lists the appropriateness of using these four alternative energy applications for 365 Alaskan communities. (MHR)

11093 **Methodology for assessment of biofuel resources in developing countries.** Harper, J.P.; Antonopolous, A.A. (TVA, Chattanooga, Tenn). *AIChE Symposium Series ;* **76**: 151-155(1980).

A methodology is described for assessing the potential of biofuel production and utilization in developing countries. The approach combines biomass resource assessment to identify appropriate biofuel options for developing countries. 4 refs.

11094 **Solar energy commercialization: whither thou goest.** Bennington, G.E. (Mitre Corp., McLean, VA); Bezdek, R. pp 2077-2081 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

It is anticipated that an appropriate national goal for solar energy will be defined shortly as a result of the Domestic Policy Review. The analysis summary is being done by the Office of Solar Applications of the Department of Energy to assist implementation planning by: providing a finer grain of detail in regional technology utilization goals; assessing physical, institutional, financial, and research requirements to achieve a range of goals; and providing growth trajectories which may be used as checkpoints to assess the progression towards a range of goals. In providing a detailed, internally consistent set of regional technology utilization goals and a description of requirements and implications for accelerated solar commercialization, it is hoped that the process of planning implementation strategies will be put in a realistic and approachable context. The impacts were analyzed for a Reference Case based on the incentives in the National Energy Act (NEA) and three levels of accelerated commercialization expected to result in the fossil fuel equivalent of 19 quads, 23 quads, and 26 quadrillion Btu of solar energy per year by the year 2000.

11095 **Effect of ownership alternatives on the life cycle costs of small power systems.** Davis, R.B. (Jet Propulsion Lab., Pasadena, CA). pp Paper 7, 193-212 of Energy: the new rules. Newman, D.T. (ed.). Santa Monica, CA; Management Education Corporation (1979).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

A model was developed to define the life-cycle cost of investment in various power technologies to a variety of owners. The Solar Thermal Economic Analysis Methodology (STEAM) described is based on the principles of life-cycle analysis. The case

studies that the model has been and will be applied to in the future are structured so as to focus on those future trends, laws, regulations, and technological developments which are expected to create economic competitiveness for non-conventional technologies such as solar thermal in applications for which there is a demand less than 10 MWe or 100 MMBtu/h.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

REFER ALSO TO CITATION(S) 11289, 11290, 11291, 11528

11096 **(AD-A—086018) Electron conductivity in combustion plasmas. Final report Oct 77-Oct 79.** Pitchford, L.C.; Beaty, E.C. (Joint Inst. for Lab. Astrophysics, Boulder, CO (USA)). Mar 1980. 41p. NTIS, PC A03/MF A01.

The major uncertainty in the calculation of the conductivity in certain plasmas representative of those produced as combustion products in MHD generators is due to the uncertainty in the low energy momentum transfer cross sections for electron scattering in water vapor. The most reliable values of such low energy cross sections are those deduced from electron swarm experiments. The determination of cross sections from swarm experiments involves solving the Boltzmann equation for the electron energy distribution function using some assumed trial set of cross sections. Certain integrals of the distribution function yield the quantities measured in swarm experiments, such as drift velocities and diffusion coefficients. By comparing the calculated values of these measurable quantities with those found experimentally, it is possible to reach useful conclusions about the trial set of cross sections. An iterative procedure can then allow deduction of a set of cross sections which is consistent with swarm observations. The low energy cross sections are thus determined and are some of the most reliable available.

11097 **(AD-A—087022) Tests of a lightweight 200 kW MHD channel and diffuser. Final report Mar 77-Dec 78.** Holt, J.F.; Pearson, J. (Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH (USA)). Mar 1980. 76p. NTIS, PC A05/MF A01.

A 200 kW lightweight MHD generator channel and diffuser were tested over a regime of 235 individual firings of the open cycle combustor systems. The diagonal conducting wall channel delivered full rated power with no interelectrode breakdown. Vibration measurements indicated no fatigue of the channel structure.

11098 **(ANL/MHD—80-7) User's guide for the GSMP/OCMHD system code.** Dennis, C.B.; Berry, G.F. (Argonne National Lab., IL (USA)). Dec 1980. Contract W-31-109-ENG-38. 114p. NTIS, PC A06/MF A01.

The Systems Analysis group of the ANL Engineering Division conducts overall system studies for various power plant concepts, utilizing a computer simulation code. Analytical investigations explore a range of possible performance variables, in order to determine the sensitivity of a specific plant design to variation in key system parameters and, ultimately, to establish probable system performance limits. To accomplish this task, a Generalized System Modeling Program (GSMP) has been developed that will analyze and simulate the particular system of interest for any number of different configurations, automatically holding constraints while conducting either sensitivity studies or optimizations. One system investigated, while developing the ANL/GSMP code, is an open-cycle magneto-hydrodynamic (OCMHD) power plant. By linking mathematical models representing these OCMHD power plant components to the executive level GSMP driver the resulting system code, GSMP/OCMHD, can be used to simulate any OCMHD power plant configuration. This report, a user's guide for GSMP/OCMHD, describes the process for setting up an OCMHD configuration, preparing the input defining that configuration, running the computer code and interpreting the results generated.

11099 **(ANL/MHD—80-18) Coal-fired open-cycle liquid-metal magnetohydrodynamic topping cycle for retrofit of steam power plants.** Pierson, E.S.; Herman, H.; Petrick, M.; Boom, R.W.; Carlson, L.; Cohen, D.; Dubey, G.; Grammel, S.J.; Schreiner, F.; Snyder, B.K.; Zinneman, T. (Argonne National Lab., IL (USA)). Dec 1980. Contract W-31-109-ENG-38. 113p. NTIS, PC A06/MF A01.

The application of the new, coal-fired open-cycle liquid-metal MHD (OC-LMMHD) energy-conversion system to the retrofit of an existing, oil- or gas-fired conventional steam power plant is evaluated. The criteria used to evaluate the retrofit are the new plant efficiency and the cost benefit relative to other options, i.e., continuing to burn oil, a conventional retrofit to burn coal (if possible), and an over-the-fence gasifier for boilers that cannot burn coal directly. The OC-LMMHD cycle and the existing steam plant used in the study are discussed, and a detailed description of the retrofit plant is presented. The latter includes plant drawings, description of the coupling of the OC-LMMHD topping cycle and the steam boiler, drawings and descriptions of the major components in the retrofit plant, and costs. The unique capability of the OC-LMMHD cycle to control the pollutants normally associated with burning coal is discussed. The net plant output powers and efficiencies are calculated, with allowances for the required auxiliary powers and component inefficiencies, and a plant lifetime economic analysis performed by an architect/engineer. The efficiency and cost results are compared with the values for the other options.

11100 **(DOE/ET/10815—43) MHD coal-fired flow facility. Quarterly technical progress report, July-September 1979.** Dicks, J.B.; Chapman, J.N.; Crawford, L.W. (Tennessee Univ., Tullahoma (USA). Space Inst.). 14 Nov 1979. Contract AC02-79ET10815. 42p. NTIS, PC A03/MF A01.

In this third quarterly report of 1979, the University of Tennessee Space Institute (UTSI) reports on significant activity, project and task status, planned research, testing, and development, and conclusions with respect to the Magnetohydrodynamics (MHD) Coal-Fired Flow Facility (CFFF) and the Research and Development Laboratory. This quarter, work on the CFFF progressed with only minor problems. The weather was generally favorable to most outside work. The extent toward completion for all work presently scheduled is now about 93%. In the chemistry laboratory, experiments with pulverized coal and potassium carbonate (K_2CO_3) continued. Data indicated that the pulverizing operation unit could be improved by operating at a slightly higher temperature. Doing this, however, should not be a problem. Continued testing of platinum and iridium cladding on anode caps has shown that these materials seem to perform well. The degradation experienced is acceptable and should not pose any problem. This information will be used in developing more oxidant resistant electrodes. Despite initial promise, the Direct Reduction Seed Regeneration process does not seem to be a viable means of seed regeneration. Detailed evaluation of the Tomlinson-Tampella and Formate processes will begin next quarter.

11101 **(DOE/ET/10815—48) Downstream component corrosion in coal-fired MHD power plants.** White, M.K. (Tennessee Univ., Tullahoma (USA). Space Inst.). Jun 1980. Contract AC02-79ET10815. 66p. NTIS, PC A04/MF A01.

Results are given to date of corrosion probe studies conducted to evaluate the nature and severity of degradation of oiler and superheater materials in coal-fired MHD power generation systems. Tests were conducted with two air or nitrogen cooled probes in Cell III of the UTSI MHD facility. One probe had carbon steel samples subjected to metal temperatures of from 547K to 719K and reducing (SR = 0.85) gas conditions to simulate boiler tube conditions. The exposure time to date on these samples is 240 minutes. The other probe had samples of carbon steel, chromium-molybdenum steels and stainless steels subjected to temperatures ranging from 811K to 914K with oxidizing (SR = 1.15) gas conditions. The total run time on these samples was 70 minutes. The boiler probe samples were found to undergo predominantly pitted type corrosion beneath a deposit of ash/seed material having approximately 34% K_2SO_4. Weight loss rates varied from about 1.5×10^{-4} gm/hr-cm^2 at the cool end of the probe to about 5.5×10^{-4} gm/hr-cm^2 at the hot end. This loss is attributed primarily to sulfidation by hydrogen sulfide. Resistance to scaling of superheater materials in-

creased progressively with the degree of alloying. Attack appeared to be in the form of surface scales containing mixtures of oxides and is attributed to either gaseous oxidation or to the presence of complex potassium trisulfates.

11102 **(DOE/ET/11058—T1) Oxygen enrichment for open cycle magnetohydrodynamic power systems.** (Gilbert/Commonwealth, Reading, PA (USA)). Jun 1979. Contract AC01-77ET11058. 50p. NTIS, PC A03/MF A01.

Efficient coal fired, open cycle MHD power generation systems require a combustion flame temperature of approximately 4600 F to provide adequate electrical conductivity in the MHD gas. To achieve this high flame temperature, either highly preheated combustion air or oxygen enrichment of combustion air preheated to a lower temperature is required. Since directly and separately fired high temperature air preheaters are not sufficiently advanced in development to ensure their reliable operation in near term MHD systems, oxygen enrichment may be the practical alternative for obtaining required flame temperatures in the near future. The work presented is a preliminary evaluation of economic and performance effects due to oxygen enrichment of combustion air in open cycle MHD power systems. Studies were initiated with a literature search and a comprehensive review of previous studies of oxygen enrichment in MHD systems. Summaries of these studies and their conclusions are contained in Appendix A. Using selected references from the literature as a starting point, sets of ground rules and assumptions were established for conducting an updated study with subsonic MHD channels. A NASA-developed computer code for modeling of the combustion products and establishing plasma properties was utilized, with slight modification, to prepare a base of thermal properties. Assuming Montana Rosebud coal and combustion air enriched with oxygen from 0 to 50% (by mass), a series of Mollier diagrams was prepared for the complete range of oxygen enriched cases (Appendix B). (WHK)

11103 **(DOE/ET/11058—T2) MHD retrofit of steam power plants. Feasibility study. Summary and conclusions, Part I.** (Gilbert/Commonwealth, Reading, PA (USA)). Jul 1979. Contract AC01-77ET11058. 276p. NTIS, PC A13/MF A01.

The US Department of Energy Division of Magnetohydrodynamics (DOE/MHD) initiated this study to evaluate the feasibility of a retrofit option to reduce the time and cost of commercializing MHD. The MHD retrofit option will integrate a nominal 260 megawatt thermal (MWt) MHD topping cycle into an existing or scheduled private utility steam plant; this facility will test both the MHD system and the combined operation of the MHD/steam plant. The 260 MWt input level was determined to be the size which could most effectively demonstrate and verify the engineering design and operational characteristics of a coal-fired, open-cycle, MHD power plant. Details are presented. A goal of the MHD program is to have operational by the year 2003 a commercial size, fully integrated MHD plant. This would be accomplished by demonstrating commercial scale, baseload performance of a fully integrated, MHD/steam power plant. (WHK)

11104 **(DOE/ET/11058—T4) Oxygen-enriched air production for MHD power plants.** (Gilbert/Commonwealth, Reading, PA (USA)). May 1980. Contract AC01-77ET11058. 46p. NTIS, PC A03/MF A01.

Direct coal-fired MHD/steam power plants using preheated, oxygen-enriched air offer the near-term potential of attractive power plant efficiencies, operating flexibility, and improved reliability compared to plants with separately-fired or directly-heated air preheaters. Systems analyses of various MHD/steam power plants indicate that maximum plant efficiency is achieved by directly preheating combustion air with high temperature combustion products from the MHD topping cycle. However, difficulties in developing regenerative preheater materials to continuously withstand the corrosive, erosive, and fouling action of hot potassium and slag-laden gases preclude the use of directly-heated high temperature air preheaters in first generation MHD plants. Previously, high power consumption for oxygen production has limited the consideration of oxygen enrichment for MHD application. Therefore, the Magnetohydrodynamics Division of the Department of Energy (DOE/MHD) requested Gilbert Associates, Inc. (GAI) to develop and then analyze information on minimum power requirements and plant costs for oxygen production for a range of oxygen enrichments and delivery pressures. Such information will facilitate evaluation of oxygen-enriched MHD system performance and economics. An analysis of several of the cryogenic air separation process cycle variations and compression schemes that have been designed to minimize net system power requirements for supplying pressurized, oxygen-enriched air to the combustor of a 2000 MWt (coal input) baseload MHD power plant is presented. (WHK)

11105 **(EPRI-AP—1639) Feasibility of the inflow disk generator for open-cycle MHD power generation. Final report.** Eustis, R.H. (Stanford Univ., CA (USA). Dept. of Mechanical Engineering). Dec 1980. 147p. NTIS, PC A07/MF A01.

A feasibility study of the inflow disk MHD generator for baseload applications was performed. Each design element, i.e., the combustor, the inlet flow path, the generator channel, the diffuser and the magnet, was studied in detail in order to provide a comprehensive assessment of the inflow disk generator. A detailed comparative study of the heat loss effect of a single combustor vs multiple combustors for the inflow disk generator was conducted based on available combustor scaling laws. The heat and momentum losses in the inlet path were calculated for the combustion gas of Montana Rosebud coal with preheated air under the slagging wall condition. The tangential variation of the thermodynamic and electrical properties at the inlet of the channel due to these losses was calculated, and its effect on the generator performance was estimated. A series of water flow visualization experiments was conducted using a scale model of a baseload generator in order to study the flow field at the generator inlet. The performance of the conical diffuser to be combined with the inflow disk generator was estimated based on the available data. The intensity and the distribution of the magnetic field were calculated for the single-coil magnet and for the split-pair magnet. Based on these results, the performance of the inflow disk generator was calculated for two different thermal inputs: 1250 MW(th) and 2500 MW(th). It was shown that the performance of the inflow disk generator is similar to that of the diagonal generator within the uncertainty of the analysis.

11106 **(FE—2215-13(Vol.3)) Critical contributions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.** Louis, J.F. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Apr 1979. Contract AC01-76ET10765. 648p. NTIS, PC A99/MF A01.

Portions of document are illegible.

Thirty-eight MIT papers on MHD generators published, printed, or submitted for publication during the period June 1975 through December 1978 are presented; complete papers are included. Separate abstracts were prepared for 20 of the papers. 18 papers were previously included in the data base. (WHK)

11107 (FE—2215-13(Vol.3), pp 15p, Paper II.1) **Ceramics in magnetohydrodynamic systems.** Bowen, H.K. (Massachusetts Inst. of Tech., Cambridge). Apr 1979.

In Critical contributions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.

The success of MHD power generation with its high conversion efficiency is intimately connected with the science and engineering of ceramic materials. While the system requirements seem overwhelming, recent development programs discussed which have involved ceramics research groups have demonstrated creative solutions and alternative design schemes. The success of this technology is dependent on the link between the MHD system engineer and the materials specialist.

11108 (FE—2215-13(Vol.3), pp 22p, Paper II.3) **MHD electrode-insulator micro- and macro-structure.** Bates, J.L. (Battelle-Northwest Labs., Richland, WA); Rossing, B.R.; Bowen, H.K. Apr 1979.

In Critical contributions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.

The development of MHD electrode modules for coal-fired and for clean fuel fired MHD channels has required the development of compatible materials for high current flux electrical conductors, high temperature insulators and current lead-outs. Large

thermal gradients due to high heat fluxes (50 to 200 watts/cm²), potassium seed condensation and subsequent reaction, and slag-seed interactions with the materials causes restructuring of the micro- and macro-structure. Results from current modules based on ZrO_2-CeO_2 and spinel (e.g., $FeAl_2O_4$-Fe_3O_4) electrodes; MgO, Al_2O_3 and $MgAl_2O_4$ insulators; and platinum or steel current-leadouts are discussed.

11109 (FE—2215-13(Vol.3), pp 12p, Paper II.6) **Fabrication and performance of MHD electrodes.** Cannon, W.R.; Pober, R.L.; Bowen, K. (Massachusetts Inst. of Tech., Cambridge). Apr 1979.

In Critical contributions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.

Ultimately the life of MHD electrodes will be limited by their ability to withstand the chemical, thermal and electrical conditions of the MHD environment. As improved materials are being developed to withstand these environments, improved fabrication techniques are necessary to reduce the porosity and increase the strength, and thus to reduce the rate of degradation by the environment. Plasma sprayed coatings may be improved by adjusting the enthalpy of the flame and the powder characteristics. An understanding of the effects of these changes on the physical nature of the coating provides useful guides for processing improvements. Fabrication, microstructure, thermal shock resistance, and MHD electrode module test results of plasma arc sprayed ceramics are reported. (WHK)

11110 (FE—2215-13(Vol.3), pp 6p,) **Properties and test results of super-hot wall electrode materials.** Cannon, W.R.; Yoshimura, M.; Mizusaki, J.; Sasamoto, T.; Pober, R.L.; Hart, J.; Bowen, H.K.; Louis, J.F. (Massachusetts Inst. of Tech., Cambridge). Apr 1979.

In Critical contributions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.

Studies in the laboratory and in an MHD channel simulator have been made to relate the chemical stability to the performance. New materials have been investigated for use as hot electrodes (T > 1700°C) from the ternary $LaFeO_3$-$SrZrO_3$-SrFeO/sub 3-x/ and from the binary system $La_{0.75}Sr_{0.25}(Fe_{0.05}Cr_{0.5})O_3$-$SrZrO_3$. Phase diagrams are presented as well as electronic conductivity and phase stability data for several compositions. A quantitative formula has been developed to determine chemical potential of the elements in the electrode or slag and is based on physical properties data and operating conditions. This expression allows for the prediction of the stability of the materials due to electrochemical effects.

11111 (FE—2215-13(Vol.3), pp 7p, Paper II.8) **Two-dimensional effects in disk MHD generators.** Dvore, D.S.; Martinez-Sanchez, M.; Shamma, S.E. (Massachusetts Inst. of Tech., Cambridge). Apr 1979.

In Critical contributions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.

Results of a numerical study of the effects and dynamics of wakes in disc generators with swirl are presented. First, the flow field and the distribution of transport properties are fixed, and the purely electrodynamic problem is solved for a range of parameters. The main effects are seen to be a reduction of the open-circuit voltage and of the maximum efficiency, with secondary reductions of the maximum current. An increase in the Hall parameter makes these effects stronger, but swirl reduces them. An idealized treatment using the parallel layer model is seen to underpredict the performance significantly. Finally, some results are presented for cases where the flow field is allowed to evolve under the MHD interaction; the results are interpreted in the light of a simple parallel-stream model.

11112 (FE—2215-13(Vol.3), pp 7p, Paper II.13) **Molecular gas performance of a disk generator with swirl.** Loubsky, W.J.; Lytle, J.K.; Teare, J.D.; Louis, J.F. (Massachusetts Inst. of Tech., Cambridge). Apr 1979.

In Critical contributions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.

Initial molecular gas performance results in a disk generator with inlet swirl are presented. Plasma properties are analyzed and compared with a chemical kinetics model of the channel flow for test conditions: T_0 = 3400 K, P_0 = 6.6 atm at B = 3.0 Tesla for a mixture of 80% N_2-20% CO_2. The channel flow is characterized by chemical nonequilibrium and low interaction. The measured electron density is consistent with the results of the model, and nearly a factor of seven lower than would be predicted by assuming chemical equilibrium of the carrier gas. Nonuniformities associated with electrothermal plasma turbulence and the presence of wakes lead to a lower Hall coefficient than predicted in the rear portion of the generator. The performance results are encouraging; a peak power density of 20 MW/m³ was achieved for a radial interaction length of only 7.5 cm. Open-circuit values of E-field and Hall coefficient as high as 22 kV/m and 4, respectively, were determined. The results of this study are not directly applicable to full-scale commercial disk generators.

11113 (FE—2215-13(Vol.3), pp 10p, Paper II.14) **MHD interaction and plasma properties in a shock tube driven disk generator with swirl.** Loubsky, W.J.; Lytle, J.K.; Teare, J.D.; Louis, J.F. (Massachusetts Inst. of Tech., Cambridge). Apr 1979.

In Critical contributions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.

A 15 cm diameter shock tube with cesium injection is used to investigate the relatively new concept of inlet swirl in a disk generator for high efficiency MHD power generation. Flow interaction effects and plasma properties in a small disk with inlet swirl and Mach number of 45° and 2.2, respectively, are emphasized. Electron density and temperature, voltage, and pressure measurements in the generator are used to analyze nonequilibrium ionization processes and effective plasma properties for tests in argon, in N_2 and with N_2/CO_2 mixtures. Plasma luminosity photos reveal several unique features of the MHD interaction. The significant results presented include (1) the behavior of electro-thermally induced nonuniformities, which reduce the average Hall parameter and electrical conductivity in both inert and reacting molecular gases at low pressure, (2) the complexities of the flow structure, with interaction of wakes, trailing edge shocks behind each inlet swirl guide vane, and Lorentz shocks, and (3) the effects of chemical nonequilibrium in the disk when driven by N_2/CO_2. The molecular gas data are in agreement with calculations using a kinetics model which includes both the neutral chemistry and three-body recombination for electrons. The relevance of these experiments to generator performance is discussed.

11114 (FE—2215-13(Vol.3), pp 15p, Paper II.15(Add.)) **Kinetics effects on the performance of a disk generator with swirl driven by combustion gases.** Loubsky, W.J.; Teare, J.D.; Louis, J.F.; Cohen, H.D. (Massachusetts Inst. of Tech., Cambridge). Apr 1979.

In Critical contributions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.

The performance and plasma properties of a small parallel-wall disk generator with 45° inlet swirl are analyzed for molecular gases typically encountered in open-cycle MHD applications. Experimental results are compared with both equilibrium calculations and a chemical kinetics model of the channel flow for test conditions: T_0 = 3400 K, P_0 = 6.6 atm at B = 3.0 Tesla for mixtures of $N_2/CO_2/H_2$. The principal results were: (1) Hydrogen addition improves the generator performance (~ 50% increase in power and enthalpy extraction) as a result of binary CO-O recombination; however, the channel flow is still characterized by chemical nonequilibrium. Good agreement with the kinetics model was found for the performance near short circuit. At open circuit, agreement was found when the effective properties were used in Ohm's law. (2) Although the MHD interaction is low, a peak power density of 31 MW/m³ was achieved for a radial interaction length of only 7 cm. This compares favorably with larger linear channels which are less affected by chemical nonequilibrium. With chemical equilibrium and a uniform plasma, a peak power density of 285 MW/m³ was calculated. E-fields as high as 26 k V/m and effective Hall coefficients up to 4.3 were obtained in the first half of the generator. Near the generator exit, the Hall parameter saturates as a result of ionization instabilities owing to low pressure and high ideal Hall parameter. (3) Initial criteria based on binary scaling of the neutral gas chemistry suggest that the design of small-scale (including CDIF size) supersonic MHD generators should include the effects of chemical kinetics. Channels sized for commercial use are expected to be in chemical equilibrium.

11115 (FE—2215-13(Vol.3), pp 11p, Paper II.17) **Effects of slagging in MHD generator ducts. ASME Paper 77-HT-59.** Martinez-Sanchez, M. (Massachusetts Inst. of Tech., Cambridge); Sadovnik, I. Apr 1979.

In Critical contributions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.

An analysis of the fluid-dynamic, heat transfer and electrical effects of the slag layers that form on the walls of coal-fired magnetohydrodynamic generators is presented. The mutual interactions of slag and plasma are calculated in a consistent manner and the results illustrate the effects of a wide range of slag types, amounts of slag runoff from the burner and wall temperature, for both subsonic and supersonic channels. The slag layer is discussed in detail, and the effects of variable properties, segmentation, and electromagnetic dissipation and forces are accounted for. The plasma flow is represented by a quasi-one-dimensional model with modifications to account for finite segmentations and boundary layer effects. It is found from the results that current leakages through slags of high conductivity can seriously degrade the generator performance, while improved thermal insulation and reduced electrode voltage drops can result in an improved performance for more resistive slags. Other effects are discussed quantitatively, and a general conclusion is that an accurate assessment of the effect of slagging must be done in each particular case, since several, often competing mechanisms are simultaneously present.

11116 (FE—2215-13(Vol.3), pp 13p, Paper II.20) **Collapse of the inter-electrode breakdown arc in the magnetic field direction.** Oliver, D.A. (Massachusetts Inst. of Tech., Cambridge). Apr 1979.

In Critical contributions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.

A two-dimensional inter-electrode breakdown arc which is uniform in the magnetic field direction is shown to be unstable. The growth time for the instability is of the order of the arc development time. It is unlikely that a fully steady two-dimensional arc is ever established. The relationship of the instability to recent experiments revealing an inherently three-dimensional breakdown is discussed.

11117 (FE—2215-13(Vol.3), pp 4p, Paper II.22) **Test results on the spinel electrode module in laboratory and simulated MHD environment.** Pober, R.L.; Nash-Webber, J.; Yoshimura, M.; Bowen, H.K. (Massachusetts Inst. of Tech., Cambridge). Apr 1979.

In Critical contributions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.

Based on the desirable and the required properties of materials for MHD electrodes, insulators and current-leadouts, the spinel electrode module has been designed and developed for coal-fired MHD generators; but it also has potential in clean-fired systems. The module consists of: an electrode based on $FeAl_2O_4$-Fe_3O_4 but may contain other dopants, e.g., Cr_2O_3 or MgO; aluminum oxide as the insulator although MgO or $MgAl_2O_4$ may also be used; and the current leadout is an iron based material, e.g., stainless steel. The important physical property data of this module are being measured and are reported briefly. In addition the experience gathered on the fabrication and testing of the modules under simulated MHD conditions are reported. The close coupling of laboratory measurements to experience under MHD conditions has allowed improvement of the design and construction of the module.

11118 (FE—2215-13(Vol.3), pp 15p, Paper II.25) **Heat transfer and kinetic limitations in the design of single-stage coal-fired combustors for open-cycle MHD generators.** Sarofim, A.F.; Howard, J.B.; Padia, A.; Kobayashi, H. (Massachusetts Inst. of Tech., Cambridge). Apr 1979.

In Critical contributions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.

A simplified model of a coal-burning combustor has been used to parametrically study the effects on combustor performance of air preheat (1100 to 1600°K), fuel/air equivalence ratio (0.95 to 1.05), pressure (4 to 8 atmospheres) and gas residence time (30 to 125 milliseconds). The results provide a measure of the influence on peak gas temperature, heat transfer to walls, or carbon burnout of different cycle parameters. Suggested further refinements of the model are identified based on work in progress on the kinetics of coal devolatilization and burnout and on the behavior of ash during the combustion process. Alternate paths to char and volatile formation need to be considered since the effect of particle temperature history on char yields is shown to have a marked influence on the residence times computed for effectively complete combustion. Allowance for the temperature differential between the coal and gas and the fine scale distribution of ash in coal need to be considered snce these are shown to be important for the calculation of ash rejection and vaporization.

11119 (FE—2215-13(Vol.3), pp 25) **Electronic conduction and thermopower of magnetite and iron aluminate spinels.** Mason, T.O.; Bowen, H.K. (Massachusetts Inst. of Tech., Cambridge). Apr 1979.

In Critical contributions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.

Electrical conductivity and thermoelectric power measurements of magnetite and iron aluminate spinels at high temperature confirm a small polaron model of electronic conduction. Electrical properties corroborate the previously established cation and defect model. Iron cations become randomly distributed between sublattices at the highest temperature. An n-to p-transition therefore occurs at the 50% Fe_3O_4-50% $FeAl_2O_4$ composition. Cation and defect equilibria appear to be composition-dependent. Iron containing spinels are considered as candidate electrode materials for coal-fired MHD generators.

11120 (FE—2215-13(Vol.3), pp 32) **Electrical breakdown strength of alumina at high temperature.** Yoshimura, M.; Bowen, H.K. (Massachusetts Inst. of Tech., Cambridge). Apr 1979.

In Critical contributions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.

The dc electrical strength of sapphire and polycrystalline alumina was studied up to 1400°C for possible application as electrical insulators in MHD generators. The electrical strength was essentially identical for both materials. It was $> 10^6$ V/cm at room temperature, and decreased gradually with temperatures up to 900°C (2.6×10^5 V/cm), then dropped rapidly to 2×10^4 V/cm at 1400°C for sample thickness of approximately 100 μm. The electrical strength decreased with the sample thickness. It was inversely proportional to the thickness for samples thicker than $\sim$ 600 μm at 1200°C. The breakdown behavior was explained on the basis of a thermal breakdown model.

11121 (FE—2215-13(Vol.3), pp 40) **Integral analysis of boundary layers in slagging MHD generators.** Gertz, J.B. (Massachusetts Inst. of Tech., Cambridge). Apr 1979.

Thesis.

In Critical contributions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.

The General Process Engineering System (GPES) has been designed as a generalized framework which can be used to create different kinds of simulation systems for process engineering, each suited to the needs of a particular set of users. This has been accomplished by having generalized data structures represent the elements of a thermodynamic (or chemical) process flowsheet such as units, streams, compounds, etc. However, to create a particular simulation system, one must define these data structures and provide computer programs to perform process unit operations. The model was applied to simulate the performance of three MHD generators: a small subsonic generator similar to the Soviet U-02 generator, a supersonic generator based on AVCO's MARK VI-C channel, and an intermediate-sized subsonic generator similar to the Russian built U-25, 1-B channel. The U-02 and MARK IV were modeled with slagged walls while the U-25 was modeled without slag. In all cases equilibrium chemistry was chosen throughout the boundary layer. Procedures and results are reported. (WHK)

11122 **(GAI—2075-A) Preliminary analysis of 500 MWt MHD power plant with oxygen enrichment. Final report.** (Gilbert/Commonwealth, Reading, PA (USA)). Apr 1980. Contract AC01-77ET11058. 59p. NTIS, PC A04/MF A01.

An MHD Engineering Test Facility design concept is analyzed. A 500 MWt oxygen enriched MHD topping cycle integrated for combined cycle operation with a 400 MWe steam plant is evaluated. The MHD cycle uses Montana Rosebud coal and air enriched

to 35 mole percent oxygen preheated to 1100°F. The steam plant is a 2535 psia/1000°F/1000°F reheat recycle that was scaled down from the Gilbert/Commonwealth Reference Fossil Plant design series. Integration is accomplished by blending the steam generated in the MHD heat recovery system with steam generated by the partial firing of the steam plant boiler to provide the total flow requirement of the turbine. The major MHD and steam plant auxiliaries are driven by steam turbines. When the MHD cycle is taken out of service, the steam plant is capable of stand-alone operation at turbine design throttle flow. This operation requires the full firing of the steam plant boiler. The MHD compressors are steam turbine driven instead of electric motor driven which minimizes shifts in main steam turbine flow when operation changes from combined cycle to stand-alone service. A preliminary feasibility assessment is given, and results on the system thermodynamics, construction scheduling, and capital costs are presented. (WHK)

11123 **(GAI—2088) Influence of diffuser performance on commercial MHD/steam power plants. Final report.** (Gilbert/Commonwealth, Reading, PA (USA)). Dec 1979. Contract AC01-77ET11058. 92p. NTIS, PC A05/MF A01.

The Department of Energy, Division of Magnetohydrodynamics (DOE/MHD), requested Gilbert/Commonwealth to investigate the effects of diffuser pressure recovery coefficient, design characteristics and heat loss (to the feedwater for cooling the diffuser) on the performance of MHD/steam combined cycle power plants and on the MHD channel. This study was conducted in two parts: (1) a literature survey of diffuser designs applicable to MHD to determine the diffuser state of the art, and (2) a systems analysis of the influence of diffuser design characteristics, pressure recovery and heat loss on the MHD channel design and on the MHD/steam power plant performance. Results are reported. The overall conclusion of the study is that while a diffuser's performance (pressure recovery and heat loss) and its geometry affect MHD channel design, MHD/steam plant performance is not significantly affected. (WHK)

11124 **(GAI—2099) Variation in steam bottoming cycle efficiency when feedwater is used as the coolant for MHD components. Part I: series displacement of feedwater heaters. Final report.** (Gilbert/Commonwealth, Reading, PA (USA)). Jan 1980. Contract AC01-77ET11058. 45p. NTIS, PC A03/MF A01.

MHD power plants are designed as binary cycles; i.e., the MHD subsystem is the topping cycle and its exhaust gas provides the primary source of heat to the steam bottoming cycle. Because of the high temperatures achieved by the combustor exhaust gas in the topping unit, cooling of the MHD components is required. To maximize overall power plant efficiency, the low temperature heat obtained in this cooling process must be utilized effectively by the bottoming cycle. The method of integrating this low temperature heat from the topping cycle into the bottoming cycle will have a substantial influence on overall bottoming cycle efficiency. This study investigated the effect imposed on the steam bottoming cycle design by the requirement that bottoming cycle feedwater be used to cool MHD components and established the influence of these designs on bottoming cycle efficiency. Five design arrangements of the secondary source, feedwater heaters, and the economizers were investigated. Both subcritical and supercritical steam cycles were considered. Results are presented. (WHK)

11125 **(GAI—2101) Variation in steam bottoming cycle efficiency when feedwater is used as the coolant for MHD components. Part II: series and parallel arrangements of feedwater heaters, and low pressure steam generation. Final report.** (Gilbert/Commonwealth, Reading, PA (USA)). Jan 1980. Contract AC01-77ET11058. 47p. NTIS, PC A03/MF A01.

The results of Part II of a two-part study conducted by Gilbert/Commonwealth to determine the variation in steam bottoming cycle efficiency when feedwater is used as the coolant for MHD topping cycle components are presented. Part I, presented in a separate volume, considers the effect on bottoming cycle efficiency as regenerative feedwater heating is displaced by heat from MHD components in the topping cycle. The MHD components are arranged in series with remaining regenerative feedwater heaters. Both supercritical and subcritical bottoming cycles are studied. This part of the study considers the variation in steam bottoming cycle efficiency as regenerative feedwater heating is displaced by heat from MHD components in both series and parallel arrangements. In addition, the effect on bottoming cycle efficiency is considered when heat from MHD components is used to generate low pressure steam for expansion through a turbine. This study is confined to supercritical bottoming cycles.

11126 **(GAI—2152) Preliminary analysis of MHD retrofit for the Colstrip power plant.** (Gilbert/Commonwealth, Reading, PA (USA)). Jun 1980. Contract AC01-77ET11058. 75p. NTIS, PC A04/MF A01.

The US DOE Office of Magnetohydrodynamics has established a development program to demonstrate the commercial feasibility of magnetohydrodynamic power generation through the operation of an Engineering Test Facility (ETF). Two MHD power system designs as candidates for the Engineering Test Facility are presented. The two system designs involve open-cycle MHD power trains retrofitted to the coal fired Colstrip power plant owned by the Montana Power Company. Under retrofit operation, the MHD topping cycle generates electric power from hot (4500°F) coal combustion gas flowing through the MHD generator, and produces steam for the Colstrip plant from heat recovered from combustion gas leaving the MHD generator. The Colstrip plant acts as a steam bottoming cycle, receiving a portion of its steam supply from the MHD heat recovery system. A portion of the plant steam supply is also obtained from the original Colstrip boiler. A retrofit facility reduces construction time and cost from what would be required for an entirely new MHD test facility by using not only the available steam cycle equipment, but most of the supplemental facilities as well. One retrofit system employs an oxygen enriched, direct fired MHD power train in which the combustion oxidizer is a mixture of air and oxygen preheated to a moderate temperature (1100°F). The preheat is obtained in a recuperative type heat exchanger. The other retrofit system uses an MHD power train with nonenriched air preheated to a high temperature (2500°F) as the oxidizer; preheat is obtained in a regenerative type heat exchanger subsystem that is fired separately with oil. A preliminary design and cost estimate for each retrofit system is presented. (WHK)

11127 **(GAI—2176) Effects of coal cleaning and slag rejection on the mass and composition of slag and seed in an MHD gas flow train.** (Gilbert Associates, Inc., Reading, PA (USA)). Sep 1980. Contract AC01-77ET11058. 66p. NTIS, PC A04/MF A01.

As part of the MHD program, DOE is sponsoring efforts to define the design criteria and performance requirements for components downstream of the diffuser in an MHD gas flow train. The objectives of this study are to assess the effects of coal cleaning and combustor slag rejection on the mass flow rate and composition of the slag and seed in an MHD flow train. Included in this assessment is an evaluation of the impacts on the design and material selection for the downstream components. This assessment was done by using equilibrium calculations to define the mass fraction, chemical composition, and properties of the slag carryover as a function of coal type, coal cleaning method, and slag temperature. Until experimental data are available, equilibrium calculations provide the best indication of the environment in the downstream components. From a survey of the literature on physical cleaning of coals, the effect of cleaning on the ash composition of the MHD reference coals was correlated and this information was used to predict the composition of a cleaned MHD coal. Equilibrium calculations of the carryover from a raw and cleaned Montana Rosebud coal were made at selected state points of a specific MHD flow train (the DOE 200 MWe Baseline ETF cycle). In addition, three different levels of slag rejection were considered for the raw coal. Slag rejection was assumed to take place only at the first stage of the combustor. Liquid slag will be present in the radiant boiler and, in practice, some portion of the slag may be removed there. However, for this scoping study, no slag rejection in the radiant boiler was assumed. Results are presented and discussed.

11128 Corrosion behavior of metallic materials in the reducing environments characteristic of a coal-fired MHD generator. Singh, R.N.; Natesan, K. *Corrosion ;* **36**: No. 5, 230-241(May 1980).

The corrosion behavior of carbon steel, chromium-molybdenum ferritic steels, austenitic stainless steels, and nickel base alloys, has been evaluated after exposure to complex gas mixtures that simulate a coal fired MHD environment with substoichiometric combustion. Carbon steel and Cr-Mo steels suffered sulfidation attack, while the austenitic stainless steels exhibited superior resistance to corrosion. Low cost ferritic steels with a stainless steel cladding or a ramming refractory coating can be used for protection of the radiant boiler components. 11 refs.

3003 Thermoelectric Generators

11129 Internal geometry of alkali metal thermoelectric generator devices. Hunt, T.K. (to Ford Motor Co). US Patent 4,220,692. 2 Sep 1980. Filed date 28 Feb 1979. vp.

Electrolyte geometry in alkali metal thermoelectric generator devices that alters the view thereof seen by cooler condenser regions provides an increase in power generating area without undesirably concomitant increase in radiation heat transfer.

3005 Fuel Cells

11130 (AD-A—086579) Aqueous trifluoromethanesulfonic acid fuel cells. Interim technical progress report Jun 78-Aug 79. George, M. (Energy Research Corp., Bethel, CT (USA)). Dec 1979. 47p. NTIS, PC A03/MF A01.

Subscale hydrogen-air fuel cells were successfully operated with 6M TFMSA as the electrolyte at temperatures as high as 60 C. The fuel cell performance was enhanced over similarly loaded electrodes in H_3PO_4 due to the apparent improved kinetics for the oxygen reduction reaction. A variety of unsupported and supported Pt electrocatalysts could be effectively utilized. TFMSA fuel cells could be operated stably for periods as long as 3000 hours if water balance was maintained. Activity coefficients calculated by the van Laar equations were utilized to predict water partial pressures of dilute TFMSA solutions.

11131 (ANL—80-98) Advanced fuel cell development. Progress Report, April-June 1980. Pierce, R.D.; Arons, R.M.; Dusek, J.T.; Fraioli, A.V.; Kucera, G.H.; Poeppel, R.B.; Sim, J.W.; Smith, J.L. (Argonne National Lab., IL (USA)). Nov 1980. Contract W-31-109-ENG-38. 27p. NTIS, PC A03/MF A01.

Advanced fuel cell research and development activities at Argonne National Laboratory (ANL) during the period April-June 1980 are described. These efforts have been directed toward understanding and improving components of molten carbonate fuel cells and have included operation of a 10-cm square cell. Studies have continued on the development of electrolyte structures ($LiAlO_2$ and Li_2CO_3-K_2CO_3). This effort is being concentrated on the preparation of sintered $LiAlO_2$ as electrolyte support. Tape casting is presently under investigation as a method for producing green bodies to be sintered; this technique may be an improvement over cold pressing, which was used in the past to produce green bodies. The transition temperature for the β- to γ-$LiAlO_2$ allotropic transformation is being determined using differential thermal analysis. Work is continuing on the development of preoxidized, prelithiated NiO cathodes. Two techniques, one of which is simpler than the other, have been developed to fabricate plates of $Li_{0.08}Ni_{0.99}O$. In addition, electroless nickel plating is being investigated as a means of providing corrosion protection to structural hardware. To improve its cell testing capability, ANL has constructed a device for improved resistance measurements by the current-interruption technique.

11132 (DOE/EV/73002—1(Vol.3), pp 16.1-16.44) Fuel cells. 1980.

In Alaska Regional Energy Resources Planning Project. Phase 2: coal, hydroelectric and energy alternatives. Volume III. Alaska's alternative energies and regional assessment inventory update.

The history of fuel cell use and fuel cell technology are reviewed for potential use in remote Alaskan communities. The cell types, reference electrodes, electrolytes, support system, advantages, disadvantages, reference power plant, and environmental impact are described. (MHR)

11133 (LA-UR—81-293) Prospects of fuel cells with alkaline, solid-polymer, and superacid electrolytes as power sources for electric vehicles. Srinivasan, S. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 38p. (CONF-801242—1). NTIS, PC A03/MF A01.

From Electric and hybrid vehicle advanced technology seminar; Pasadena, CA, USA (8 Dec 1980).

Fuel cells are most promising as power sources for electric vehicles. Performance is comparable to that of internal-combustion-engine vehicles but with the additional advantage of higher fuel efficiency, particularly with synthetic fuels from coal. The state of the art and expected progress with fuel cells using alternatives to phosphoric acid as the electrolyte, that is, alkaline, solid polymer, and superacid electrolytes is reviewed. Alkaline fuel cells are appealing because of the good performance at less than 100°C and potential for finding nonnoble metal catalysts, but are handicapped by the fact that pure hydrogen will have to be stored and used as the fuel. The solid-polymer electrolyte fuel cell has the best prospects for attaining the highest power densities, which are important from the point of view of reducing cost, weight, and volume of the power plant. However, this type of fuel cell uses an expensive electrolyte membrane and has a difficult water management problem. Enthusiasm is growing for the development of fuel cells using organic superacids as the electrolyte. The bulk of the studies to date are with aqueous trifluoromethanesulfonic acid. Electrode kinetics of the oxygen reduction action are sufficiently enhanced in the superacids as compared with phosphoric acid. The noble metal content of the electrodes can be minimized and perhaps eliminated in fuel cells with such electrolytes.

11134 (NYSERDA—80-14) Selection of candidate sites for the instrumentation phase of the 40 kW fuel cell demonstration project. Rizzuto, J. (Gibbs and Hill, Inc., New York (USA)). Aug 1980. 73p. NYSERDA, Albany, NY.

Nine candidate sites are recommended for instrumentation in the Brooklyn Union Gas/New York State Energy Research and Development Authority 40 kW Fuel Cell Demonstration Program. The nine businesses have been selected from 400 potential candidates drawn mostly from the small business community in the Brooklyn Union service territory. Site surveys of energy use and building compatibility were performed at the 36 candidates from this group which appeared, based on telephone surveys, to meet certain selection criteria and which expressed an interest in participating in the program. Thirty-one businesses from this latter group supplied sufficient information to permit site evaluation and were further considered for site selection. The thirty-one candidates are compared based on estimated gross operating savings that each would have realized in 1980 if they were powered by two 40 kW fuel cells rather than their existing power systems. This comparison is made excluding ownership costs and taxes. The nine businesses with the greatest estimated gross operating savings were chosen, excluding those with site or installation problems. The savings for the selected sites ranged from $24,451 to $8,330. The corresponding fuel cell capital costs that these candidates would find economically feasible range from $1029/kW to $254/kW. The recommended candidates fall into five market segments; they include two diners (24-hour restaurants), two food processors, two textile dyers, two commercial laundries, and one bowling alley.

11135 (PSI-TR—248) Impact on soot control measures on MCFC powerplants. Task report No. 4. Bloomfield, D.P. (Physical Sciences, Inc., Woburn, MA (USA)). 12 Dec 1980. Contract AC21-80MC14361. 50p. NTIS, PC A03/MF A01.

Physical Sciences Inc. has performed a preliminary evaluation of the effects of soot control measures on the molten carbonate fuel cell powerplant. Soot control measures are required because of the temperature and humidity restrictions imposed on the system by the low temperature gas cleanup system. The system configuration chosen is the General Electric System 1 configuration. This system

uses a Texaco, oxygen blown gasifier and a low temperature (Selexol) gas cleanup system. The pressure of this portion of the system is about 600 psi which drops to 500 psi at the exit of the gas cleanup system. The gas which at this point has dew point of 100°F is expanded to about 105 psi. At this point, steam is injected. The function of this steam is to suppress soot formation both in the anode inlet preheater and in the molten carbonate fuel cell (MCFC) anode. GE alludes that the function of the steam may also be to optimize the output of the steam turbines. Upon leaving the anode, the sensible heat in the anode exhaust is used to regeneratively preheat the anode inlet gas. Finally, the anode exhaust is fed to a catalytic combustor via a compressor. The combustor effluent is mixed with fresh cathode inlet air. This stream is then mixed with cathode exhaust recycle. The resulting mixture is fed to the MCFC cathode. The cathode exhaust is split into recycle and system exhaust streams. About 77% of the cathode exhaust is recycled. The system exhaust is expanded through a gas turbine, a regenerative heat exchanger and an economizer. Results of the study are reported. (WHK)

11136 **Cell and fuel cell electrodes having poly(phosphazene) binder.** Auborn, J.J. (to Bell Telephone Laboratories Inc). US Patent 4,223,080. 16 Sep 1980. Filed date 11 May 1979. vp.

Cells or fuel cells having two or more electrodes and an electrolyte are described in which at least one of the electrodes has, in addition to the active electrode material, a poly(Phosphazene) polymer which is a binder.

3008 Miscellaneous Converters

11137 **Dielectric thermal power converter.** Drummond, J.E. (to Maxwell Labs Inc). US Patent 4,220,906. 2 Sep 1980. Filed date 8 Apr 1977. vp.

A method and apparatus is disclosed for use in converting heat to electrical energy and comprises a plurality of capacitors which have a temperature dependent capacitance. Heat is used to decrease the dielectric constant in the capacitors causing charge to expand from the capacitors into an associated circuit and do electrical work. The invention also includes reeds which are caused to vibrate by the flow of vapor carrying heat between stages. These reeds serve as thermal switches which pulse heat at the proper frequency and phase through a large number of stacked capacitors. The efficiency of the apparatus is optimized by operating the individual capacitors through cycles approximating carnot cycles.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 11043, 11088

11138 **Foresight. Volume 3. The economic impact of energy conservation, proceedings of an engineering foundation conference, 1978.** Bodilly, S.J.; Kaufman, A. (Eds.). Washington, DC; GPO (1979). 492p.

This conference proceedings contains 34 papers covering the various aspects of energy conservation including its potentials and limitations; its effect on the U.S. economy; its impact on transportation, automobile fuel economy, building economies, utilities, and manufacturing; and perspectives on the economic impacts of energy conservation.

11139 **Energy: the new rules.** Newman, D.T. (ed.). Santa Monica, CA; Management Education Corporation (1979). 969p. (CONF-790358—).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

Separate abstracts are for 19 original presentations at the proceedings. Many presentations previously published are included. A separate abstract is also prepared for the texts of the National Energy Act. (MCW)

3201 Buildings

REFER ALSO TO CITATION(S) 10976, 11010, 11045, 11074, 11089, 11196, 11212

11140 **(AD-A—086842) A study of Central Energy Monitoring and Control (CEMC) systems. Master's thesis.** Rudich, W.L. (Naval Postgraduate School, Monterey, CA (USA)). 9 May 1979. 138p. NTIS, PC A07/MF A01.

The Central Energy Monitoring and Control (CEMC) systems began in the 1950s as an attempt to reduce rising labor costs in building management. The ensuing development of the computer and the mini-computer which created more sophisticated systems and the start of the 'energy crisis' started their application for energy reduction and optimization in facilities. This report explains the components of a computer-based CEMC system, its functions and its capabilities. Other types of systems are briefly described for comparison. The terminology peculiar to CEMC systems is defined and some of the systems available today are described. The results of questionnaires sent to present users of these systems are discussed. The problem with the specification and procurement of CEMC systems is presented. The source of the problem and some solutions proposed by other are given. The use of CEMC systems on College Campuses is discussed. The history of the proposed system installation on the University of Colorado Boulder campus is reviewed and updated.

11141 **(DOE/CS—0185) Energy efficiency standards for eight consumer products: public meeting clarification, questions and answers.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy). Aug 1980. 151p. NTIS, PC A07/MF A01.

Eighteen corporations and manufacturers provided answers to many questions posed at a public meeting on energy efficiency standards for eight consumer products. Questions on the regulations concerning the manufacturing standards, performance standards, and testing standards are included. Questions were posed about air conditioners, refrigerators, refrigerator-freezers, stoves (ranges), ovens, clothes dryers, oil fired burners, water heaters, furnaces, etc. A presentation containing information pertaining to the values of average annual energy consumption per unit used by DOE in its analysis leading to proposed energy efficiency standards for nine types of consumer products is included. (MCW)

11142 **(DOE/CS/10315—T1) Energy management handbook for building operating engineers student workbook.** (Enviro-Management and Research, Inc., Washington, DC (USA)). Sep 1979. Contract AC01-78CS10315. 489p. NTIS, PC A21/MF A01.

The handbook provides operating engineers with the basic information needed to implement specific energy conservation opportunities, and additional information is presented relative to the formulation and development of the energy management plan. Chapters are entitled: The Need for Energy Management (International Factors, The US Energy Situation, Energy and the Building Owner); The Fundamentals of Energy Consumption in Buildings (Energy Basics, Heat Basics, Heat Flow and the Building Envelope, Air and Comfort, Factors Affecting Energy Use In Buildings); Principles of Energy Conservation (Building Energy Consumption Characteristics); Planning the Energy Management Program (Obtaining Commitment and Support, Establishing the Energy Use Index, Organizing to Develop the Plan, Developing and Implementing the Plan); Conducting a Survey of Facilities and Operations (The Energy Audit, Preparation of Building and Systems Profile, Measurement and Instrumentation); Guidelines for Energy Conservation (Operator ECO's, Owner ECO'S); Developing the Draft Final Plan (Analyze Survey Findings, Putting the Plan on Paper, Review and Submit); Implementing the Program (Developing the Final Plan, Implementing the Plan, Monitoring and Updating the Program). A glossary is included and specific information on degree days and cooling hours for some selected cities and a computer energy study data for the New York Hilton are included in appendices. (MCW)

11143 (DOE/CS/15223—01) Energy considerations in real estate appraising. (Society of Real Estate Appraisers, Chicago, IL (USA)). Apr 1980. Contract EM-78-G-01-5223. 173p. NTIS, PC A08/MF A01.

Purposes of the seminar on the subject, the basis of this report, include the following: (1) to provide the appraiser an opportunity to learn how to identify and analyze the actual physical consumption of energy as well as the energy-saving improvements in properties under appraisal and in comparable sale and lease properties; (2) to help the appraiser in developing methods to keep meaningful records on the energy consumption of subject and comparable properties so as to observe in an orderly way the behavior of buyers, sellers, tenants, landlords, borrowers, and lenders with respect to energy efficiency; and (3) to assist the appraiser in learning to measure the relative sensitivities of the various segments of the market to energy considerations as indicated by differences in sale prices and rentals. To achieve these goals, the seminar employed two case studies, one for a angle-family residence and one for a multi-family building, both in Topeka, Kansas. The case studies are for illustrative purposes only; in applying the lessons of the seminar to their own daily work, students should be careful to develop information that is pertinent to their subject properties and subject areas and not rely on any of the particulars laid out in the cases.

11144 (DOE/CS/40048—T4) Environmental control for confinement livestock housing. Jones, D.D.; Friday, W.H.; DeForest, S.S. (Purdue Univ., Lafayette, IN (USA). Cooperative Extension Service). Jun 1980. Contract AS02-77CS40048. 19p. NTIS, PC A02/MF A01.

Advantages and disadvantages of mechanical ventilation systems for livestock housing are discussed. Various principles involved in environmental control are reviewed. The design, operation, maintenance, and management of the equipment needed for environmental control are discussed. (JGB)

11145 (DOE/R5/10111—1) Low infiltration-high insulation house construction. Final report. Churchill, J. (Churchill (J.) Construction, Inc., Macomb, IL (USA)). 24 Nov 1980. Contract FG02-79R510111. 11p. NTIS, PC A02/MF A01.

A description of a low infiltration, high insulation house is given. The 1440-square foot, single family house features innovative construction techniques using standard materials. Special double thick and double insulated walls were built. The ceiling was specially built and crawl space was insulated heavily and the band joist assembly was re-designed so as to eliminate the band joist and sill plate completely. These details are represented. Records were kept on energy consumption of the electric heat system, the water heater, and the air conditioner, and data on these are presented. (MCW)

11146 (EPRI-EA—1649) Analysis of field test data on residential heating and cooling. Final report. Talbert, S.G.; Jakob, F.E.; Fischer, R.D. (Battelle Columbus Labs., OH (USA)). Dec 1980. 129p. NTIS, PC A07/MF A01.

The present project was designed to further validate and improve the computer program using field site data that had been collected on 48 homes located in six cities in different climatic regions of the United States. In addition, a User's Guide was prepared for the computer program which is contained in a separate two-volume document entitled User's Guide for REAP: Residential Energy Analysis Program. The program, REAP, is now available from EPRI. Feasibility studies were also conducted pertaining to potential improvements for REAP, including: the addition of an oil-furnace model; improving the infiltration subroutine; adding active and/or passive solar subroutines; incorporating a thermal energy storage model; and providing dual HVAC systems (e.g., heat pump/gas furnace). The intended purpose of REAP is to enable building designers and energy analysts to evaluate how such factors as building design, weather conditions, internal heat loads, and HVAC equipment performance, influence the energy requirements of residential buildings.

11147 (ORNL/SUB—7559/3) Problems associated with the use of urea-formaldehyde foam for residential insulation. Part III. Residential studies in Colorado and Wisconsin. Schutte, W.C.; Cole, R.S.; Frank, C.W.; Long, K.R. (Iowa Univ., Oakdale (USA). Dept. of Preventative Medicine and Environmental Health). Feb 1981. Contract W-7405-ENG-26. 36p. NTIS, PC A03/MF A01.

Formaldehyde levels were measured in homes in problem and non-problem areas in Wisconsin and Colorado to elucidate the severity and the extent of formaldehyde emission under field conditions, help correlate laboratory findings with field observations, and investigate the cause and effect relationship between insulation stability and weather conditions of an area. Methods for selecting homes and sampling are described. Interviews were conducted with occupants of the homes and the data are tabulated. Results are summarized. Investigation forms are shown and weather information in Denver and Wisconsin is tabulated. (MCW)

11148 (ORNL/SUB—7559/4) Problems associated with the use of urea-formaldehyde foam for residential insulation. Part IV. Relevance of materials standards to problems associated with the use of urea-formaldehyde foam insulation. Long, K.R.; Schutte, W.C. (Iowa Univ., Oakdale (USA). Dept. of Preventative Medicine and Environmental Health). Feb 1981. Contract W-7405-ENG-26. 19p. NTIS, PC A02/MF A01.

The insulation industry is essentially self-regulated; therefore, the question arises as to whether or not increased public regulation would be effective in controlling problems associated with the use of urea-formaldehyde foam as residential insulation. The relevancy of public regulation to controlling problems such as off-gassing of formaldehyde associated with the use of the products through the introduction of materials standards and quality assurance of manufacture and installation is discussed. The use of urea-formaldehyde insulation may be divided into three phases-manufacture, installation, and behavioral phases. The relevance of materials standards and quality assurance for each phase is discussed.

11149 (P—400-80-072) Guide to the energy conservation regulations for new nonresidential buildings: Guide to Lighting, Division g. (California Energy Commission, Sacramento (USA)). Sep 1980. 69p. California Energy Commission, Sacramento, CA.

Information is provided to assist designers and building officials in applying the Energy Conservation Standards for Lighting of New Nonresidential Buildings (Division 9). Three basic design criteria are applied in determining whether or not lighting designs for new nonresidential buildings are in compliance. The design must: provide only enough light to meet the requirements of the tasks being performed in the area; restrict necessary high levels of illumination to the precise local areas in which special tasks are being performed; and provide enough switching flexibility to allow unneeded lights to be turned off and unnecessarily high levels of illumination to be reduced. These rules are described and illustrations are given on how to use them.

11150 (PB—80-179591) Simulating the housing allowance program in Green Bay and South Bend: a comparison of the urban institute housing model and the supply experiment. Vanski, J.; Ozanne, L. (Urban Inst., Washington, DC (USA)). Jun 1978. Contract HUD-H-2162R. 101p. NTIS, PC A06/MF A01.

Predictions are made about the 1980 outcomes of the Housing Allowance Supply Experiment (HASE) in Green Bay (Brown County, Wis.,) and South Bend (St. Joseph County, Ind.). They are based on Urban Institute's Housing Market Model, data about the two sites prior to 1975, and 1980 projections of population, income, and housing costs. Predictions are compared to the first 2 years of program results and found to be consistent with the market effects predicted in previous simulations of housing allowance programs for the 1960 - 1970 decade. Considerably more than half the eligible population participates in the program, and the average participant substantially increases his housing consumption. In Green Bay, where rapid population growth is predicted to have already forced the price of housing close to the price needed to elicit additional supply, the model finds little price increase from the program; how-

ever, in South Bend, which is losing population and appears to have a decaying stock, the simulations find participants must pay sharply higher prices to obtain housing improvements. Neither enrollments nor demands for housing improvement show signs of rising sharply in either site; hence, there is unlikely to be much pressure on the existing supply of housing by 1980. One implication from the comparisons is that the program participation and housing consumption responses of the model need strengthening. The true strength of the model cannot be evaluated precisely until accurate input data for 1980 can be given and the model and the analysis of the experimental data are completed. The appendix discusses model inputs for the 1970 - 1980 projections. Tabular and graphic data and a bibliography are provided.

11151 **(PB—80-811466) Energy conservation through building design. 1964-May, 1980 (citations from the NTIS data base). Report for 1964-May 80.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 140p. NTIS PC N01/MF N01.

Federally-funded research on energy conservation through design of residential and commercial buildings is discussed. Topic areas cover the impact of building codes and standards on new construction and retrofitting of existing buildings, energy calculations for new building design, methods for estimating life cycle costs of alternative energy conservation techniques, inclusion of thermal insulation during building design, and window strategies. (This updated bibliography contains 133 abstracts, 42 of which are new entries to the previous edition.)

11152 **(PB—80-811474) Energy conservation through building design. 1970-May, 1980 (citations from the Engineering Index data base). Report for 1970-May 80.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 157p. NTIS PC N01/MF N01.

Citations from worldwide literature on energy conservation through design of both residential and non-residential buildings are discussed. Topic areas cover solar radiation considerations in building planning and design, daylighting and window design, use of computer graphics for buildings, and architectural design concepts. (This updated bibliography contains 150 abstracts, 42 of which are new entries to the previous edition.)

11153 **(SERI/TP—721-1008) Implementation of an analytical verification technique on three building energy-analysis codes: SUNCAT 2.4, DOE 2.1, and DEROB III.** Wortman, D.; O'Doherty, B.; Judkoff, R. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1981. Contract AC02-77CH00178. 10p. (CONF-810405—6). NTIS, PC A02/MF A01.

From 3. annual systems simulation, economic analysis/solar heating and cooling operational results conference; Reno, NV, USA (27 Apr 1981).

An analytical verification technique for building energy analysis codes has been developed. For this technique, building models are developed that can be both solved analytically and modeled using the analysis codes. The output of the codes is then compared with the analytical solutions. In this way, the accuracy of selected mechanisms in the codes can be verified. The procedure consists of several tests and was run on SUNCAT 2.4, DOE 2.1, and DEROB III. The results are presented and analyzed.

11154 **Descriptive documentation for New Mexico Gasoline Econometric Final Demand Model.** Baxter, J.D.; Ben-David, S. Albuquerque, NM; University of New Mexico (1981). 21p. (NP—25228). New Mexico Energy and Minerals Department, Santa Fe.

The coverage provided by the model extends over passenger cars, light trucks, and out-of-state passenger cars. It computes consumption and residential energy demands for scenario development in SWEEP, but can stand alone. It reflects dollars spent per region and inputs to SWEEP's petroleum products sector (Section 18). The total figure overrides the consumer final demand allocated regionally from INFORUM by the location quotient method. The princpal simulation with the model is in the area of price changes. (MCW)

11155 **Heat exchange apparatus.** Pravda, M.F. (to Dynatherm Corp). US Patent 4,222,436. 16 Sep 1980. Filed date 21 Dec 1978. vp.

Bidirectional heat exchangers and elements for use therein are provided for application in buildings and other enclosures to introduce fresh outside air and to remove exhaust air while coincidently recovering heat from the warmer air and using it to adjust the temperature of the cooler air.

11156 **Apparatus for conserving energy in electrical appliances.** Grimes, J.C.; Payne, J.R.; Pierce, R.L.; Schlaifer, N. US Patent 4,223,301. 16 Sep 1980. Filed date 10 Apr 1978. vp.

An apparatus for connecting and disconnecting appliances to an electrical supply, responsive to door activated switch means is given. A transmitter responds to entrance into a room by causing a receiver to activate a connecting means supplying an appliance with electrical energy. Upon closure of the door, a deadbolt must be engaged within the room within a predetermined period to maintain the appliances in their energized states. Release of the deadbolt to exit from the room causes the transmitter to enter a delay sequence, thereby providing an occupant with sufficient time to exit prior to de-energizing the appliances. Subsequent thereto, a signal is transmitted to the receiver for shutdown of the appliances. An overriding thermostat is provided to control heating and cooling appliances responsive to the transmitter, the thermostat having a broader thermal zone of operation than a typical thermostat controlling the heating and cooling appliances in the presence of the room occupant. An occupant-activated switch is provided to override the deadbolt and control the transmitter under certain circumstances.

11157 **Efficient heating and domestic hot water apparatus.** Gerstmann, J.; Pompei, F. (to Boston Gas Products Inc). US Patent 4,222,350. 16 Sep 1980. Filed date 26 Jun 1978. vp.

An efficient, compact boiler system providing both heating water for heating an enclosed space, such as a home, and domestic hot water for washing and similar purposes, has a limited fluid capacity primary heating coil within a combustion chamber. The coil supplies heated water to a larger capacity storage boiler located directly below the primary boiler and connected to it by header pipes which themselves form a manifold into which the primary coil is connected. The storage boiler distributes the heated water through the heating system. An elongated secondary heating coil within the boiler heats the domestic hot water supply by heat transfer from the boiler water. The return header pipe discharges heated water directly into the interior loop of the secondary coil to quickly heat the domestic hot water when the burner is "on".

11158 **Temperature compensated control for air conditioning system or heat pump.** Harnish, J.R. (to Borg-Warner Corp). US Patent 4,221,116. 9 Sep 1980. Filed date 5 Jun 1978. vp.

A temperature compensated safety control is employed to shut off the compressor at high compression ratios, caused, for example, by reduced air flow over the condenser or other reasons. This is especially useful on both reverse cycle heat pumps and conventional, non-reversible refrigeration and air conditioning systems to protect the compressor. In a preferred embodiment, the temperature compensation is provided by making the control responsive to outdoor ambient air temperatures.

11159 **Refrigeration heat pump changeover valve assembly.** Nelson, R.E. (to Honeywell Inc). US Patent 4,221,237. 9 Sep 1980. Filed date 28 Jun 1978. vp.

A refrigeration heat pump changeover valve assembly has a cylindrical housing with a slidable valve member in the housing for changing the flow of refrigerant in a refrigeration heat pump system. The evaporator and condenser lines are connected on one side of the housing adjacent each other in line with the axis of the housing. The compressor suction line and discharge or pressure line are connected on the other side of the housing opposite the evaporator and condenser lines adjacent each other at right angles to the axis of the cylindrical housing. The valve member upon moving between a first and a second position upon the operation of a pilot

valve connects the suction line to either the evaporator or condenser line when in the first or second position, respectively, and the discharge line is connected to the other line. The valve assembly provides for low pressure drop , straight through flow of the refrigerant into the suction line and from the discharge line to either the evaporator or condenser lines depending upon the operation of the self-contained pilot valve system.

11160 Control and measuring system for flat-individual heating/cooling and procedure for the system's calibration. Kuokkanen, L.; Otala, M.N. (to Insele Oy (Finland)). US Patent 4,221,260. 9 Sep 1980. Filed date 28 Aug 1978. vp.

The present invention concerns a control and measuring system for flat-individual heating/cooling, meant to serve the purposes of charging for the total heating/cooling energy consumption individually per flat. The system comprises room thermostats, which govern the valves of heating radiators or cooling evaporators. The thermostats and valves present an on/off design and measuring pick-ups for the heating/cooling fluid temperature on the outgoing and return sides. A connecting unit for transfer of the measurement data to a central unit is responsible for data processing and output. Systems which would enable the heating or cooling energy consumed in each individual flat to be determined and charged have not been developed to a usable level up to date. Such a system has been considered disproportionately expensive in view of the savings of energy consumption that could be achieved and since it has even been thought impossible to work out a system which would render possible the equitable and accurate charging for each flat individually.

11161 Loss of refrigerant and/or high discharge temperature protection for heat pumps. Mueller, D.A.; Serber, S.L. (to Honeywell Inc). US Patent 4,220,010. 2 Sep 1980. Filed date 7 Dec 1978. vp.

A loss of refrigerant and/or high discharge temperature detection and control system for a reverse cycle refrigeration system is given. It provides a fault indication whenever the temperature of the compressor discharge refrigerant is at or above a predetermined value (which value is a function of the magnitude of the outdoor air temperature) and which functions further by inhibiting the operation of the compressor of the reverse cycle refrigeration system.

11162 Air cooled centrifugal refrigeration system with water heat recovery. Bergman, M.O.; Leary, J.W.; Sanborn, D.F.; Ware, C.D. (to Trane Co The). US Patent 4,220,011. 2 Sep 1980. Filed date 22 Dec 1978. vp.

A refrigeration system is disclosed which includes evaporator means of the type for producing chilled liquid and wherein a compressor of the centrifugal type is provided for compressing refrigerant which has been vaporized in the evaporator means. Both air cooled and liquid cooled condenser means are connected in parallel flow relationship to the compressor, whereby the heat of condensation and compression may be rejected either to a source of ambient air or recovered through heat exchange with a source of liquid, whereby a heated liquid is produced for use as desired. Conduit means which are provided for passing condensed refrigerant from the air cooled and liquid cooled condenser means to the evaporator means include valve means for selectively varying the flow of condensed refrigerant from each. The flow of condensed refrigerant from the air cooled condenser means may be reduced so as to cause at least partial flooding thereof and thereby reduce its capacity, while the flow of condensed refrigerant from said liquid cooled condenser means may be increased so as to increase the production of heated liquid. Control means are also disclosed for operating the aforesaid valve means in response to a sensed demand for heated liquid.

11163 Window shade sealing system. Marquez, F.G. US Patent 4,220,189. 2 Sep 1980. Filed date 18 Dec 1978. vp.

A complete window shade and sealing system is provided as a separate unit having peel-off adhesive permitting all portions of the system to be press-fitted onto an existing window frame, creating a completely sealed cover for the window when the shade is in its down position, preventing the entry of air, dust, radioactive fallout, etc.

11164 Heating system-generated indoor air pollution. Silberstein, S. (Brookhaven Natl Lab, Upton, NY). *Energy and Buildings ;* **2**: No. 4, 271-278(Dec 1979).

Heating systems may emit pollutants into living spaces of buildings. The paper attempts to answer the questions: how can exposure to these pollutants be estimated; and how will their concentrations be affected by energy conservation measures? In order to answer the first question, a differential equation and a simple APL program for numerical integration are derived. The model is also used to answer the second question. 12 refs.

11165 Residential space heating systems: energy conservation and economics. O'Neal, D.L. (Oak Ridge Natl Lab, Tenn). pp 174-179 of Technology energy conservation. Silver Spring, MD; Information Transfer Inc. (1979).

From 3. national conference and exhibition on technology for energy conse-vation; Tucson, AZ, USA (22 Jan 1979).

This paper examines the energy saving and increased capital cost expected with these more efficient systems (both conventional and advanced) compared to representative systems currently in use. The potential impact these more efficient systems might have in reducing growth of residential energy use is also examined. 19 refs.

11166 Resident utility billing system: a method of reducing energy waste in master-metered rental housing. McClelland, L.; Canter, S.J. (Univ of Colo, Boulder). pp 525-533 of Technology energy conservation. Silver Spring, MD; Information Transfer Inc. (1979).

From 3. national conference and exhibition on technology for energy conservation; Tucson, AZ, USA (22 Jan 1979).

Possible solutions to the problem of energy waste in master-metered rental housing take two forms, technological and behavioral. The more obvious solution, the technological, is the conversion from master-metering to individual or submeters. The Institute of Behavioral Science (IBS) at the University of Colorado is under contract to DOE to test, evaluate, and disseminate information about promising behavioral methods of encouraging conservation in master-metered buildings.

11167 Energy and economic effects of residential heat pump water heaters. O'Neal, D.L.; Haynes, V.; Hirst, E.; Carney, J. (Oak Ridge Natl Lab, Tenn). pp 534-539 of Technology energy conservation. Silver Spring, MD; Information Transfer Inc. (1979).

From 3. national conference and exhibition on technology for energy conservation; Tucson, AZ, USA (22 Jan 1979).

This paper compares the cost and energy use characteristics of three types of electric water heating systems: improved conventional, dedicated heat pump, and solar. The characteristics of each system are integrated with the ORNL residential energy use simulation model. Results suggest that all three alternatives to present-day conventional water heaters can save energy and money for households. 16 refs.

11168 Automatic vent damper for residential furnaces. Muller, J.G. (DOE, USA). pp 595-602 of Technology energy conservation. Silver Spring, MD; Information Transfer Inc. (1979).

From 3. national conference and exhibition on technology for energy conservation; Tucson, AZ, USA (22 Jan 1979).

The automatic vent or flue damper is one of several methods available for improving the efficiency of residential furnaces, heating boilers and hot water heaters. Unfortunately these devices present certain serious safety problems. This article briefly reviews various types of dampers and their safety factors.

11169 Locating and eliminating obscure but major energy losses in residential housing. Harrje, D.T.; Dutt, G.S.; Beyea, J.E. (Princeton Univ, NJ). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions ;* **85**: 521-534(1979). (CONF-790678—). Detroit, MI, USA (24 Jun 1979).

This paper outlines a number of experimental approaches for determining the energy consumption of a building, with emphasis on air infiltration. The combined use of depressurization of the house and infrared scan permits the location of "bypass" routes

through which warm air is leaving the structure. Several types of bypasses are described and evidence for their widespread existence is documented. The impact of retrofitting these and other energy loss sites is also discussed with regard to side effects on the occupants and building structure. 42 refs.

11170 **Energy conservation management for commercial and industrial facilities.** Clark, F.L. (Brown and Caldwell Consulting Engineers, Walnut Creek, CA). pp Paper 5, 161-182 of Energy: the new rules. Newman, D.T. (ed.). Santa Monica, CA; Management Education Corporation (1979).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

A practical four-phase approach, called energy conservation management, using a well-structured methodology which permits investigation, analyzation, and development of cost-effective energy conservation programs is presented. The phases are: an initial investigation to identify energy conservation opportunities; a detailed engineering investigation and development of master plan; implementation; and monitoring and follow-up recommendations made. Two specific projects are used to illustrate the approach for energy conservation management for commercial buildings. After specifically examining energy conservation management for industrial facilities, it is concluded that a substantial portion of energy consumed can be saved. (MCW)

3202 Transportation

11171 **(CONF-810111—1) State-level stock-system model of gasoline demand.** Greene, D.L. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 42p. NTIS, PC A03/MF A01.

From Annual meeting of the Transportation Research Board; Washington, DC, USA (12 Jan 1981).

A summary overview is provided of the specification and econometric estimation of a state level model of highway gasoline demand. The model was designed for policy and technology sensitive forecasting of motor fuel use by light duty highway vehicles over the period 1980 through 2000. The model is of the stock system type in that it explicitly models the demand for and technological characteristics of the stock of light duty vehicles used in consuming gasoline. The theoretical basis of the model is the household production theory of consumer demand. In this context the aggregate demand for gasoline is viewed as being conditional on the size, composition, and technology of the vehicle fleet. Because of data inadequacies the model does not model commercial and household demand separately. Econometric estimation of the model had to overcome serious multicollinearity problems in the new vehicle class demand equations. Used vehicle supply is modeled by over 200 state/class scrappage equations. Used vehicle prices are forecasted based on exogenous new vehicle prices. In all, the used vehicle model forecasts individual state fleet composition by 6 vehicle classes and 16 vintages. Issues of functional form and regional price and income elasticities were investigated in the estimation of the gasoline demand model. A constant elasticity functional form was accepted with a short run price elasticity of -0.1 and an in use fuel efficiency elasticity of -0.9.

11172 **(DOE/CS/56051—4) Fleet manager's guide to testing vehicles for valid results.** (Mueller Associates, Inc., Baltimore, MD (USA)). Feb 1981. Contract AC05-79CS56051. 38p. NTIS, PC A03/MF A01.

The managers of automotive fleets are vitally interested in saving money. Fleet procurement and operations costs are increasing rapidly. Fuel cost increases have been especially extreme. Conservation measures have included the purchase of more fuel-efficient vehicles, consolidation or reduction of unnecessary or redundant travel, upgraded and/or more frequent vehicle inspection, maintenance, repair, and the installation of fuel-saving components (or removal of fuel-consuming components). Virtually every significant cost saving measure has a cost associated with it, either a tangible financial cost, or an intangible (convenience) cost. In order to justify to his superiors that such measures should be taken, the fleet manager must be able to demonstrate clearly that the benefits derived from implementation of these measures will exceed the costs of doing so. In order to accomplish this, he must have unambiguous measures of both costs and benefits and methods of comparison which are easily usable and which yield unambiguous results. The analysis methods presented in this document are designed to accomplish this end.

11173 **(GGD—80-75) Need for tighter controls over fuel purchased by the Postal Service.** Staats, E.B. (General Accounting Office, Washington, DC (USA)). 31 Jul 1980. 34p. GPO.

Report to the Congress of the United States by the Comptroller General.

The US Postal Service uses nearly 90 million gallons of gasoline and diesel fuel each year. In fiscal year 1980, the cost of this fuel was expected to be $100 million, and the cost will increase as fuel prices continue to rise. This GAO study finds that the Service needs to change the way it controls fuel. To reduce the susceptibility to fraud, abuse, and waste in the procurement and use of fuel, GAO recommends that the Postmaster General vigorously enforce procedures for verifying fuel deliveries, including maintaining verification records for independent audit; initiate a program to test the quality of fuel received; insure that guidelines for bulk-tank security are followed at all facilities; insure that all fuel dispensed from bulk fuel tanks is accounted for; require drivers to obtain receipts from commercial service stations or record fuel and oil purchases on documents controlled by the Postal Service; and obtain better data on the use of fuel by vehicle drivers.

11174 **(PB—80-183122) Evaluation of the representativeness of EPA fuel economy estimates.** Cackette, T. (Environmental Protection Agency, Ann Arbor, MI (USA). Emission Control Technology Div.). Jan 1978. 28p. NTIS, PC A03/MF A01.

Energy conservation has become a major national commitment. An important element of this commitment is a national strategy to improve the fuel economy of the new car fleet through a regulatory program involving stringent fuel economy standards that each manufacturer must meet for its corporate sales-weighted fleet. To insure consumer cognizance of the fuel economy implications of the consumer's purchase decision, the Energy Policy and Conservation Act established a fuel economy labeling program whereby each new vehicle is posted with its expected fuel economy. The Keystone to this program is the Federal Test Procedure developed by EPA to quantify and regulate emissions reductions for environmental purposes. These same procedures are also utilized as the yardstick of fuel economy measurement. Recent suggestions that EPA fuel economy estimates significantly over-predict actual vehicle fuel economy prompted EPA to conduct a number of studies designed to explore the representativeness of the EPA methodology. The objective of this report is to summarize the results and conclusions of these studies.

11175 **(PB—80-185002) Interactions between energy supply and transportation-related energy use. Volume I. Final report.** Adler, T.J.; Ison, J.W.; Geinzer, J.C. (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). Jan 1980. 175p. NTIS, PC A08/MF A01.

This report describes the structure of ENTRANS and some of its policy analysis applications. ENTRANS is a computer simulation model of the interactions between energy supply and transportation-related energy use. It includes a complete representation of the characteristics of transportation supply (public transit, carpooling, highways, and autos) and of households' travel-related decisions (car type, travel mode, trip length, and frequency choices). The model is capable of analyzing a wide range of policies designed to change automobile fuel use. The results of several detailed policy analyses are described in this report.

11176 **(PB—80-185713) Motor vehicle tampering survey (1978). Final report.** (Environmental Protection Agency, Washington, DC (USA). Mobile Source Enforcement Div.). Nov 1978. 113p. NTIS, PC A06/MF A01.

A survey was performed to (1) assess the rate of vehicle emission tampering on a nationwide basis, (2) assess the most prevalent forms of tampering, and (3) quantify the relationship between tampering and idle test emission scores. 1953 vehicles comprising model years 1973 through 1978 were inspected in Delaware, Maine,

Virginia, Washington, Tennessee, and Texas, during state safety inspections or police roadside checks. An overall tampering rate of 5.8% was found. Tampering increased with age of the vehicle and, in general tampered vehicles had higher idle emissions. Tampering was most prevalent with the exhaust gas recirculation system.

11177 **(PB—80-188303) Consumer behavior towards fuel efficient vehicles. Volume II: consumer sentiments towards fuel efficient vehicles. Final report Sep 77-Feb 80.** Sherman, L.; Manski, C.F.; Ginn, J.R.; Hill, D.H.; Hill, M.S. (Cambridge Systematics, Inc., MA (USA)). Feb 1980. 204p. NTIS, PC A10/MF A01.

To meet the National Highway Traffic Safety Administration's (NHTSA) need for a capability of forecasting consumer response to fuel-efficient motor vehicle designs, a statistical analysis was performed on a longitudinal series of Surveys of Consumer Sentiment, administered by the University of Michigan's Survey Research Center. This volume examines a broad set of questions concerning consumer attitudes towards energy policy in general and motor vehicle-related conservation efforts in particular.

11178 **(PB—80-191075) Consumer behavior towards fuel efficient vehicles. Volume III: forecasts of the composition of household motor vehicle holdings. Final report Oct 77-Feb 80.** Sherman, L.; Manski, C.F.; Ginn, J.R. (Cambridge Systematics, Inc., MA (USA)). Feb 1980. 243p. NTIS, PC A11/MF A01.

This volume presents forecasts of household vehicle type purchases and holdings over the 1978 - 1985 period covered by Title V fuel economy Standards. The forecasts are based on an econometric model explaining the make, model and vintage composition of individual household vehicle holdings. The empirical analysis is based on a national random sample of households contacted in February, 1976. Two models are estimated, one explaining the compositions of holdings in one-vehicle households, and the other explaining vehicle choices in multiple-vehicle households.

11179 **(PB—80-191083) Consumer behavior towards fuel efficient vehicles. Volume I: executive summary. Final report Oct 77-Feb 80.** Sherman, L.; Manski, C.F.; Ginn, J.R. (Cambridge Systematics, Inc., MA (USA)). Feb 1980. 41p. NTIS, PC A03/MF A01.

This report assesses consumer behavior towards fuel-efficient vehicles designed to meet recently mandated federal fuel economy standards. The study involves a comprehensive evaluation of existing nationwide survey data as well as the development of a major new econometric forecasting model of household vehicle type choice. As a result, the report describes both an assessment of consumers' current reported sentiments toward fuel-efficient vehicles and insights into expected future changes in household vehicle purchase behavior in response to changes in vehicle designs and prices, demographics, and the energy environment.

11180 **(PB—80-193543) Weight reduction potential of automobiles and light trucks: 1979 summary source document. Final report.** Hsia, H.; Kidd, J.A. (Department of Transportation, Cambridge, MA (USA). Transportation Systems Center). Mar 1980. 194p. NTIS, PC A09/MF A01.

The purpose of this report is to provide an assessment of the potential for weight reduction for passenger cars and light trucks (including pickup trucks, vans, and utility vehicles of GVWR up to 8500 pounds) in the 1980 to 2000 model year period. Various aspects of vehicular performance are addressed. Four weight reduction scenarios involving material substitution are presented with increasing technological sophistication. In addition to the baseline data, dominant case assessments for high strength steel, fiber reinforced plastic, aluminum, and hybrid reinforced plastics are provided.

11181 **Device for controlling the running of urban transport vehicles.** Henriot, C. (to L Electronique Des Vehicules Et Des Reseaux EVR (France)). US Patent 4,220,946. 2 Sep 1980. Filed date 20 Apr 1978. vp.

A system for controlling the running of urban transport vehicles, such as buses or trams, which stop at many stops is disclosed. The system includes recording and signalling beacons spaced out along the route of the vehicles and transmission units disposed on each vehicle for transmitting data to the beacons. The data transmitted identifies the vehicle on the route and the optimum time interval before the arrival of the next vehicle. The beacons are each fitted with a clock and with a logic system for comparing the optimum and real intervals between the arrivals of two vehicles, and with lights indicating to the driver of a vehicle that he is early or late in relation to the optimum interval.

11182 **Intercity and urban gas trubine powered bus demonstration programs.** Stieber, J.G. pp 77-82 of Nonpetroleum vehicular fuels: symposium papers. Chicago, IL; Institute of Gas Technology (1980).

From Symposium on nonpetroleum vehicular fuels; Arlington, VA, USA (11 Feb 1980).

The intercity part of the program demonstrates and evaluates operation of the latest generation of gas turbine engines in intercity coaches in intercity service. The coaches will operate in different city pairs in the US for maximum environmental and data input. Urban buses will operate in Baltimore and accumulate operational data for evaluation. The urban part of the program will use five GMC RTS-II advanced designed buses operating in city streets (Phase 1). Phases 2 and 3 will use preproduction power plants in both programs. (MCW)

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11183 **(BM-RI—8499) Characterization of pre-1957 avionic scrap for resource recovery.** Dunning, B.W. Jr.; Ambrose, F. (Bureau of Mines, Avondale, MD (USA). Avondale Metallurgy Research Center). 1980. 20p. Bureau of Mines, Washington, DC.

Studies conducted to determine increased recovery and utilization methods of valuable constituents in a wide variety of domestic and industrial wastes are described. In this particular study, 36 units of obsolete electronic equipment from military aircraft were disassembled into their modular components by hand to determine materials distribution. Further modular disassembly into individual parts was used to identify metal composition. After identifying the metals in some of the more difficult to dismantle modules, similar modules were grouped together, shredded, mechanically separated, and using metal composition data from hand separation, classified along with the hand-separated materials. Although this equipment is normally classified as low-value iron-bearing aluminum, data were obtained that indicated the potential for moderately higher value classification. The electronic units were classified as to precious metals, copper, iron, and aluminum contents, and scrap values were estimated.

11184 **(BNL—28837) Process models: analytical tools for managing industrial energy systems.** Howe, S.O.; Pilati, D.A.; Balzer, C.; Sparrow, F.T. (Brookhaven National Lab., Upton, NY (USA); Purdue Univ., Lafayette, IN (USA)). 1980. Contract AC02-76CH00016. 20p. (CONF-801171—3). NTIS, PC A02/MF A01.

From 7. national conference on energy and the environment; Phoenix, AZ, USA (30 Nov 1980).

How the process models developed at BNL are used to analyze industrial energy systems is described and illustrated. Following a brief overview of the industry modeling program, the general methodology of process modeling is discussed. The discussion highlights the important concepts, contents, inputs, and outputs of a typical process model. A model of the US pulp and paper industry is then discussed as a specific application of process modeling methodology. Applications addressed with the case study results include projections of energy demand, conservation technology assessment, energy-related tax policies, and sensitivity analysis. A subsequent discussion of these results supports the conclusion that industry process models are versatile and powerful tools for managing industrial energy systems.

11185 **(BNL—28838) Process modeling and industrial energy use.** Howe, S.O.; Pilati, D.A.; Sparrow, F.T. (Brookhaven National Lab., Upton, NY (USA); Purdue Univ., Lafayette, IN (USA)). Nov 1980. Contract AC02-76CH00016. 25p. (CONF-801152—2). NTIS, PC A02/MF A01.

From Electric Power Research Institute workshop; Atlanta, GA, USA (17 Nov 1980).

How the process models developed at BNL are used to analyze industrial energy use is described and illustrated. Following a brief overview of the industry modeling program, the general methodology of process modeling is discussed. The discussion highlights the important concepts, contents, inputs, and outputs of a typical process model. A model of the US pulp and paper industry is then discussed as a specific application of process modeling methodology. Case study results from the pulp and paper model illustrate how process models can be used to analyze a variety of issues. Applications addressed with the case study results include projections of energy demand, conservation technology assessment, energy-related tax policies, and sensitivity analysis. A subsequent discussion of these results supports the conclusion that industry process models are versatile and powerful tools for energy end-use modeling and conservation analysis. Information on the current status of industry models at BNL is tabulated.

11186 **(CONF-800802—23) Computer model of a transversal flow press NIP: predictions using experimentally determined permeability and compression data.** Ellis, E.R.; Ceckler, W.H.; Thompson, E.V.; Hoering, J.F. (Maine Univ., Orono (USA). Dept. of Chemical Engineering). 1980. Contract AS02-78CS40064. 15p. NTIS, PC A02/MF A01.

From 89. annual meeting of the American Institute of Chemical Engineers; Portland, OR, USA (17 Aug 1980).

Data are presented which confirms the validity of the University of Maine at Orono computer model for predicting the behavior of paper during wet pressing. The results indicate that dynamic effects are important in describing the compressive behavior of cellulose mats and that these dynamic effects enhance the dewatering of paper in the wet press.

11187 (DOE/EV/73002—1(Vol.3), pp 19.1-19.22) **Waste heat.** 1980.

In Alaska Regional Energy Resources Planning Project. Phase 2: coal, hydroelectric and energy alternatives. Volume III. Alaska's alternative energies and regional assessment inventory update.

Waste heat recovery technology is discussed including: furnace stack energy, heat pipes, heat pipe exchangers, rotary regeneration, bottoming cycles, and applicability to Alaska. (MHR)

11188 **(DOE/NASA/0031—80/5) Cogeneration technology alternatives study (CTAS). Volume V. Cogeneration system results. Final report.** Gerlaugh, H.E.; Hall, E.W.; Brown, D.H.; Priestly, R.R.; Knightly, W.F. (General Electric Co., Schenectady, NY (USA)). May 1980. Contract AI01-77ET13111. 177p. (NASA-CR—159769). NTIS, PC A09/MF A01.

The most-attractive advanced conversion systems for implementation in industrial cogeneration systems for the 1985-2000 time period, which permit increased use of coal or coal-derived fuels, are identified and evaluated. The advantages of using advanced-technology systems in industrial cogeneration are quantified and assessed. Nine systems evaluated include: steam turbine, diesel engines, open-cycle gas turbines, combined gas turbine/steam turbine cycles, Stirling engines, closed-cycle gas turbines, phosphoric acid fuel cells, molten carbonate fuel cells, and thermionics. The systems selected showed desirable cogeneration characteristics and the capability of being developed for commercialization in the 1985 to 200 year time frame. These energy-conversion systems were then heat matched and power matched to over 50 specific industrial processes selected primarily from the six major energy-consuming industrial sectors of food; paper and pulp; chemicals; petroleum refineries; stone, clay and glass; and primary metals. Several processes were also included from wood products and textiles. On each of these matches, analyses were performed to evaluate and compare the advanced technology systems on such factors as: fuel energy saved, flexibility in fuel use, capital costs, return on investment and annual energy cost saved, emissions, and applicability to a number of industries. Earlier volumes contain information on the analytical approach, industrial-process characteristics, and energy-conversion-system characteristics; this volume presents the methodology of matching the cogeneration systems, the results of the performance analysis, an economic analysis, the national savings, and results.

11189 **(DOE/R5/10150—T1) Modernizing the handling of ear corn. Final technical report.** Kleptz, C.F. (Kleptz (Charles F.), Union, OH (USA)). 1980. Contract FG02-79R510150. 15p. NTIS, PC A02/MF A01.

The goal of the project was to modernize the handling of ear corn. The corn was picked with a three row JD 300 picker pulled by a tractor. Pulled behind the picker was a side dump wagon with a capacity of 150 bushels of ear corn. When the dump wagon was full, a grain truck was driven along side of the wagon and the dump wagon, controlled by the tractor driver, was emptied into the truck. After two dumps of the wagon, the truck was driven to the storage area. The storage area consisted of ten (ten) 2000 bushel corn cribs set in a semi circle so that the elevator that filled the cribs could be moved from one crib to the next without changing the fill point. At the storage area, the truck full of corn was dumped into the platform feeder. By using a platform feeder to feed the elevator, all ten (10) cribs could be filled without moving it. After the harvest was complete, the corn remains in the cribs until needed for feed or until the corn is sold. During the time that the corn remains in the cribs, the turbine ventilator draws air through the corn and dries it.

11190 **(IS—4751) Advanced research and technology: direct utilization-recovery of minerals from coal fly ash. Fossil energy program. Technical progress report, 1 April-30 June 1980.** Burnet, G.; Murtha, M.J.; Frederick, J. (Ames Lab., IA (USA)). Aug 1980. Contract W-7405-ENG-82. 58p. NTIS, PC A04/MF A01.

The purpose of this investigation is to develop methods to utilize coal fly ashes through processes for the extraction of alumina and titania, and for the separation and utilization of an iron-rich fraction. Research of the HiChlor process for the extraction of alumina and titania by high-temperature chlorination of a fly ash-reductant mixture has involved comparative calculations for several fly ashes, and the design of a bench-scale fluidized chlorination system. The initial chlorination research of the high-volume fly ashes from western coals was begun. Process development of the sinter process for alumina recovery has included the investigation of several variables for improving the quantity and quality of the alumina extracted from sintered materials. As a result of this work, it is clear that further optimization of the sintering and extraction variables is required for commercialization of the fly ash sinter process. Iron-rich, magnetically separated coal fly ash particles were beneficiated to a quality equal to high grade, naturally mined iron ore by a high-temperature pressurized caustic treatment. About 95% of the contained silica and 65% of the alumina was extracted. Work was begun on the assembly of equipment for a detailed comparison of magnetically separated iron-rich fly ashes and commercial magnetities for use in heavy media coal beneficiation. Characterization of the particles, ad stability and rheological properties of media solutions prepared with these materials will provide data for further evaluating magnetic fly ash as a heavy media material. A circuit is also being built for long-term flow tests of the media suspensions for measurement of construction material erosion and solid medium particle friability.

11191 **Method for removing coronene from heat exchangers.** Kmak, W.S.; Yatabe, A. (to Exxon Research And Engineering Co). US Patent 4,222,852. 16 Sep 1980. Filed date 2 Feb 1979. vp.

Coronene deposits are removed from a heat exchange zone of the reforming process by recycling a portion of the normally liquid reformate to the heat exchange zone to dissolve the coronene deposits.

11192 **Application of sulfosuccinic ester anti-fouling agents.** Durrieu, M.; Richmond, J.R.; Scherrer, C. (to Raffinage Compagnie Francaise (France); Universal Matthey Products (France)). US Patent 4,222,853. 16 Sep 1980. Filed date 28 Mar 1979. vp.

The invention relates to anti-fouling agents capable of decreasing the fouling of equipment in contact with a hydrocarbon charge.

11193 **Stack exhaust heat recycling system.** Kadan, A.; Kadan, B.Z. US Patent 4,222,349. 16 Sep 1980. Filed date 24 Apr 1978. vp.

A stack exhaust heat recycling system utilizing the heat content of exhaust gases passing through a smoke stack to the ambient atmosphere is given. The stack includes an inner shell defining a passage to carry the exhaust gases without restrictive draft. Surrounding this shell in any desired configuration is tubing carrying fluids (liquids, gas, or oils). Surrounding the tubing is an intermediate shell, insulation, and an outer shell. During the passage of the fluid through the tubing, transfer of heat occurs from the gases to the fluid so that its temperature is elevated for use, e.g., as hot water, thus eliminating or supplementing a hot water heater. Other uses requiring elevation of the temperature of water or gas may be similarly utilized.

11194 **Industry's view of the new regulations.** Gardner, S.K. pp Paper 3, 29p of Energy: the new rules. Newman, D.T. (ed.). Santa Monica, CA; Management Education Corporation (1979).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

Industry's view of regulations which seek to implement the National Energy Plan and the effect it may have on the industrial users is presented. The presentation emphasizes the proposed regulations in the Power Plant and Industrial Fuel Use Act and the Natural Gas Policy Act. The proposed regulations are found to be inflationary; overly regulatory; and exceed the letter and spirit of the law. Some prophesies on the direction of current energy policies are presented and discussed. (MCW)

11195 **Potential for inplant generation and export of electric power in the chemical, petroleum refining, and paper and pulp industries.** Nydick, S.E.; Davis, J.P. (Thermo Electron Corp., Waltham, MA). pp Paper 4, 149-159 of Energy: the new rules. Newman, D.T. (ed.). Santa Monica, CA; Management Education Corporation (1979).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

The maximum thermodynamic and economic potentials for increased inplant electric power generation by steam turbine, gas turbine, and diesel topping and steam and organic bottoming cycles were determined for the chemical, petroleum refining, and paper and pulp industries and extrapolated to all of industry. It was concluded that inplant generation both for plant sufficiency and export for consumer use can significantly contribute to US energy conservation strategy. Government-sponsored economic incentives can substantially enhance the adoption of inplant electric power generation especially for industry ownership of facilities. It is estimated that from 2080 TJ/day (340,000 bbl oil/day) to 5050 TJ/day (900,000 bbl oil/day) can be saved by 1985 in the three industries studied with economically feasible, inplant generation facilities depending on type of ownership and economic incentives. Extrapolating to all of industry results in twice these savings. Present institutional, legal/regulatory constraints will tend to restrict generation mostly to inplant use. It was concluded that regulatory and rate structure changes are probably required in order for the US to realize the full potential of inplant electric power generation.

11196 **Cogeneration applications of diesels and waste heat recovery with steam turbines.** Nydick, S.E. (Thermo Electron Corp., Waltham, MA). pp Paper 14, 241-247 of Energy: the new rules. Newman, D.T. (ed.). Santa Monica, CA; Management Education Corporation (1979).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

Two applications of cogeneration systems are described. In one application a small residual fuel-fired diesel engine is used to generate steam and electricity at Clark University. The economics of diesel cogeneration are also given for typical industrial sites. In the other application, electricity is generated from the waste heat of a cement kiln.

11197 **Cogeneration in the chemical industry.** Johns, W.L. (E.I. du Pont de Nemours & Co., Wilmington, DE). pp Paper 17, 257-279 of Energy: the new rules. Newman, D.T. (ed.). Santa Monica, CA; Management Education Corporation (1979).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

Co-generation is defined; typical co-generation installations in the chemical industry are reviewed; and how co-generation can fit into the chemical industry's future is discussed. Examples of co-generation are facilities which generate electricity or mechanical work, and then the exhaust heat from the steam turbine, combustion turbine, or internal combustion engine is used directly or indirectly as a heating medium for industrial, commercial, or space heating purposes. It is concluded that co-generation facilities, when justified, must be installed for the future financial benefit of the chemical industry. (MCW)

11198 **Cogeneration: all that glitters is not gold.** Crosby, H.L. (Weyerhaeuser Co., Tacoma, WA). pp Paper 18, 281-300 of Energy: the new rules. Newman, D.T. (ed.). Santa Monica, CA; Management Education Corporation (1979).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

A realistic and cautionary approach to applying cogeneration as a viable solution to closing the gap forecast in domestic energy supply and demand is discussed. For cogeneration to be a profitable venture over time, special conditions to be met are: a steady and continuous long-term need for steam and electricity; a favorable heat balance (economic use for exhaust steam); a steady supply of low-cost fuel; physical space for equipment and safe fuel storage; reasonable environmental requirements/regulations; acceptable logistics (such as movement of vehicles through community and on-site); and good contracts between parties involved. Weyerhaeuser developed a simulation program that permits testing the process energy balance. The Facility Energy Model is an energy balance and accounting program that provides a means of testing the energy impacts of some proposed action on a given process system. The system concept is described.

11199 **Co-generation and conservation in the aluminum industry.** Sheldon, A.C. pp Paper 16, 5p of Energy: the new rules. Newman, D.T. (ed.). San Monica, CA; Management Education Corporation (1979).

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

A brief overview of the aluminum production process is presented. The energy-intensive process has 4 distinct segments-mining and drying the ore (bauxite); refining the bauxite into aluminum oxide or alumina; smelting to reduce the oxide to aluminum and oxygen; and fabricating the metal. Energy use in each of the operations is described. Recycling in the industry is an economical venture. Capital required for building recycling facilities is one-tenth of that which is needed for new aluminum refining and smelting capacity. (MCW)

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REFER ALSO TO CITATION(S) 10423, 10459, 11018

11200 **(ANL/CNSV—12) District heating from electric-generating plants and municipal incinerators: local planner's assessment guide.** Pferdehirt, W.; Kron, N. Jr. (Argonne National Lab., IL (USA)). Nov 1980. Contract W-31-109-ENG-38. 130p. NTIS, PC A06/MF A01.

This guide is designed to aid local government planners in the preliminary evaluation of the feasibility of district heating using heat recovered from electric generating plants and municipal incinerators. System feasibility is indicated by: (1) the existence of an adequate supply of nearby waste heat, (2) the presence of a sufficiently dense and large thermal load, and (3) a favorable cost comparison with conventional heating methods. 34 references.

11201 **(CONF-800334—(Vol.2), pp 676-683) Environmental assessment of the DOE Urban Waste Program.** Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

This paper addresses the probable environmental impacts that would result from the implementation of the Department of Energy's Urban Waste Technology Program. The program is designed to encourage the development and commercial application of waste-to-energy systems for municipal solid wastes and/or

sewage sludge. Among the technologies included in this study are shredding with resource recovery, refuse-derived fuel, combustion with heat recovery, waterwall combustion, pyrolysis, anaerobic digestion, enzymatic hydrolysis, and methane recovery from landfills. The air, water, noise, odor, safety, health, ecological, and socioeconomic effects of these technologies were investigated. In most instances, existing control technologies are adequate to keep impacts within acceptable environmental standards. Nationwide, the total impacts of the program are generally favorable, with the possibility of site-specific problems due to local environmental conditions.

11202 (CONF-8009108—, pp 45-52) **Municipal waste management.** Walter, D. 1980.

From Alternate sources of energy conference; New York, NY, USA (29 Sep 1980).

Various possibilities in dealing with municipal wastes are explored, including: combustion, pyrolysis, anaerobic digestion, and recycling. Companies and projects involved in the various technologies are mentioned. Economics and financial incentives are explored. (MHR)

11203 **(DOE/CS/20289—58) Community Energy Systems and the Law of Public Utilities. Volume Six. Arkansas.** Feurer, D.A.; Weaver, C.L. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1981. Contract AC02-78CS20289. 106p. NTIS, PC A06/MF A01.

A detailed description is given of the laws and programs of the State of Arkansas governing the regulation of public energy utilities, the siting of energy generating and transmission facilities, the municipal franchising of public energy utilities, and the prescription of rates to be charged by utilities including attendant problems of cost allocations, rate base and operating expense determinations, and rate of return allowances. These laws and programs are analyzed to identify impediments which they may present to the implementation of Integrated Community Energy Systems (ICES). This report is one of fifty-one separate volumes which describe such regulatory programs at the Federal level and in each state as background to the report entitled Community Energy Systems and the Law of Public Utilities - Volume One: An Overview. This report also contains a summary of a strategy described in Volume One - An Overview for overcoming these impediments by working within the existing regulatory framework and by making changes in the regulatory programs to enhance the likelihood of ICES implementation.

11204 **(DOE/CS/20289—59) Community Energy Systems and the Law of Public Utilities. Volume Seven. California.** Feurer, D.A.; Weaver, C.L. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1981. Contract AC02-78CS20289. 113p. NTIS, PC A06/MF A01.

A detailed description is given of the laws and programs of the State of California governing the regulation of public energy utilities, the siting of energy generating and transmission facilities, the municipal franchising of public energy utilities, and the prescription of rates to be charged by utilities including attendant problems of cost allocations, rate base and operating expense determinations, and rate of return allowances. These laws and programs are analyzed to identify impediments which they may present to the implementation of Integrated Community Energy Systems (ICES). This report is one of fifty-one separate volumes which describe such regulatory programs at the Federal level and in each state as background to the report entitled Community Energy Systems and the Law of Public Utilities - Volume One: An Overview. This report also contains a summary of a strategy described in Volume One - An Overview for overcoming these impediments by working within the existing regulatory framework and by making changes in the regulatory programs to enhance the likelihood of ICES implementation.

11205 **(DOE/CS/20289—60) Community Energy Systems and the Law of Public Utilities. Volume Eight. Colorado.** Feurer, D.A.; Weaver, C.L. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1981. Contract AC02-78CS20289. 131p. NTIS, PC A07/MF A01.

A detailed description is given of the laws and programs of the State of Colorado governing the regulation of public energy utilities, the siting of energy generating and transmission facilities, the municipal franchising of public energy utilities, and the prescription of rates to be charged by utilities including attendant problems of cost allocations, rate base and operating expense determinations, and rate of return allowances. These laws and programs are analyzed to identify impediments which they may present to the implementation of Integrated Community Energy Systems (ICES). This report is one of fifty-one separate volumes which describe such regulatory programs at the Federal level and in each state as background to the report entitled Community Energy Systems and the Law of Public Utilities - Volume One: An Overview. This report also contains a summary of a strategy described in Volume One - An Overview for overcoming these impediments by working within the existing regulatory framework and by making changes in the regulatory programs to enhance the likelihood of ICES implementation.

11206 **(DOE/CS/20289—70) Community Energy Systems and the Law of Public Utilities. Volume Eighteen. Kansas.** Feurer, D.A.; Weaver, C.L. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1981. Contract AC02-78CS20289. 112p. NTIS, PC A06/MF A01.

A detailed description is given of the laws and programs of the State of Kansas governing the regulation of public energy utilities, the siting of energy generating and transmission facilities, the municipal franchising of public energy utilities, and the prescription of rates to be charged by utilities including attendant problems of cost allocations, rate base and operating expense determinations, and rate of return allowances. These laws and programs are analyzed to identify impediments which they may present to the implementation of Integrated Community Energy Systems (ICES). This report is one of fifty-one separate volumes which describe such regulatory programs at the Federal level and in each state as background to the report entitled Community Energy Systems and the Law of Public Utilities - Volume One: An Overview. This report also contains a summary of a strategy described in Volume One - An Overview for overcoming these impediments by working within the existing regulatory framework and by making changes in the regulatory programs to enhance the likelihood of ICES implementation.

11207 **(DOE/CS/20289—71) Community Energy Systems and the Law of Public Utilities. Volume Nineteen. Kentucky.** Feurer, D.A.; Weaver, C.L. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1981. Contract AC02-78CS20289. 100p. NTIS, PC A05/MF A01.

A detailed description is given of the laws and programs of the State of Kentucky governing the regulation of public energy utilities, the siting of energy generating and transmission facilities, the municipal franchising of public energy utilities, and the prescription of rates to be charged by utilities including attendant problems of cost allocations, rate base and operating expense determinations, and rate of return allowances. These laws and programs are analyzed to identify impediments which they may present to the implementation of Integrated Community Energy Systems (ICES). This report is one of fifty-one separate volumes which describe such regulatory programs at the Federal level and in each state as background to the report entitled Community Energy Systems and the Law of Public Utilities - Volume One: An Overview. This report also contains a summary of a strategy described in Volume One - An Overview for overcoming these impediments by working within the existing regulatory framework and by making changes in the regulatory programs to enhance the likelihood of ICES implementation.

11208 **(DOE/CS/20289—72) Community energy systems and the law of public utilities. Volume 20. Louisiana.** Feurer, D.A.; Weaver, C.L. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1981. Contract AC02-78CS20289. 72p. NTIS, PC A04/MF A01.

A detailed description is given of the laws and programs of the State of Louisiana governing the regulation of public energy utilities, the siting of energy generating and transmission facilities, the municipal franchising of public energy utilities including attendant problems of cost allocations, rate base and operating expense

determinations, and rate of return allowances. These laws and programs are analyzed to identify impediments which they may present to the implementation of Integrated Community Energy Systems (ICES). This report is one of fifty-one separate volumes which describe such regulatory programs at the Federal level and in each state as background to the report entitled Community Energy Systems and the Law of Public Utilities—Volume One: An overview. This report also contains a summary of a strategy described in Volume One—An Overview for overcoming these impediments by working within the existing regulatory framework and by making changes in the regulatory programs to enchance the likelihood of ICES implementation.

11209 **(DOE/CS/20289—81) Community energy systems and the law of public utilities.** Feurer, D.A.; Weaver, C.L. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1981. Contract AC02-78CS20289. 90p. NTIS, PC A05/MF A01.

A detailed description is given of the laws and programs of the State of Nebraska governing the regulation of public energy utilities, the siting of energy generating and transmission facilities, the municipal franchising of public energy utilities, and the prescription of rates to be charged by utilities including attendant problems of cost allocations, rate base and operating expense determinations, and rate of return allowances. These laws and programs are analyzed to identify impediments which they may present to the implementation of Integrated Community Energy Systems (ICES). This report is one of fifty-one separate volumes which describe such regulatory programs at the Federal level and in each state as background to the report entitiled "Community Energy Systems and the Law of Public Utilities--Volume One: An Overview." This report also contains a summary of a strategy described in Volume One - An Overview for overcoming these impediments by working within the existing regulatory framework and by making changes in the regulatory programs to enhance the likelihood of ICES implementation.

11210 **(DOE/CS/20289—86) Community energy systems and the law of public utilities. Volume thirty-four. New York.** Feurer, D.A.; Weaver, C.L. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1981. Contract AC02-78CS20289. 107p. NTIS, PC A06/MF A01.

A detailed description is presented of the laws and programs of the State of New York governing the regulation of public energy utilities, the siting of energy generating and transmission facilities, the municipal franchising of public energy utilities, and the prescription of rates to be charged by utilities including attendant problems of cost allocations, rate base and operating expense determinations, and rate of return allowances. These laws and programs are analyzed to identify impediments which they may present to the implementation of Integrated Community Energy Systems (ICES). This report is one of fifty-one separate volumes which describe such regulatory programs at the Federal level and in each state as background to the report entitled Community Energy Systems and the Law of Public Utilities - Volume One: An Overview. This report also contains a summary of a strategy described in Volume One - An Overview for overcoming these impediments by working within the existing regulatory framework and by making changes in the regulatory programs to enhance the likelihood of ICES implementation.

11211 **(DOE/CS/20289—87) Study of the impacts of regulations affecting the acceptance of integrated community energy systems. Final report.** (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1981. Contract AC02-78CS20289. 134p. NTIS, PC A07/MF A01.

A detailed description is presented of the laws and programs of the State of North Carolina governing the regulation of public energy utilities, the siting of energy generating and transmission facilities, the municipal franchising of public energy utilities, and the prescription of rates to be charged by utilities including attendant problems of cost allocations, rate base and operating expense determinations, and rate of return allowances. These laws and programs are analyzed to identify impediments which they may present to the implementation of Integrated Community Energy Systems (ICES). This report is one of fifty-one separate volumes which describe such regulatory programs at the Federal level and in each state as background to the report entitled Community Energy Systems and the Law of Public Utilities - Volume One: An Overview. This report also contains a summary of a strategy described in Volume One - An Overview for overcoming these impediments by working within the existing regulatory framework and by making changes in the regulatory programs to enhance the likelihood of ICES implementation.

11212 **(PB—80-173420) Neighborhood conservation and property rehabilitation. Bibliography.** (Department of Housing and Urban Development, Washington, DC (USA). Library Div.). Oct 1979. 110p. NTIS PC MF A01.

This annotated bibliography contains 812 citations of useful and readily available studies and periodical articles on the topic of neighborhood conservation and property rehabilitation. No newspaper articles are included. Some of the specific subject areas covered are urban revitalization, neighborhood organization and citizen participation, neighborhood conservation, rehabilitation, renovation, restoration, recycling, remodeling, central cities and downtowns, economic and commercial development, mixed - use development, adaptive use, displacement and relocation, abandoned buildings, and urban homesteading. Also included are citations covering financing and tax incentives, historic preservation, redlining, code enforcement, foreign experience, and bibliographies. Names and addresses of resource organizations and periodical and newsletter sources are provided. A geographic index in two parts (cities, towns, and counties; States, regions, and countries) and an author index are also included.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

11213 **Heat engine.** Negishi, M. US Patent 4,222,239. 16 Sep 1980. Filed date 29 Sep 1977. vp.

A heat engine using as the working medium a non-compressible substance such as a liquid or a solid. The non-compressible substance in an enclosure is moved alternately relative to and between a high temperature zone and a low temperature zone to undergo expansion and contraction, which are transmitted directly or indirectly as mechanical displacement by an output piston. As the non-compressible substance, polyethylene or paraffin is most desirable.

11214 **Electromagnetic power generator.** Adams, R.T.; Baum, M.C.; Freedman, R.P.; Pappas, D.G.; Small, S.N. US Patent 4,220,907. 2 Sep 1980. Filed date 27 Jul 1978. vp.

An electromagnetic power generator is described for installation in the interior of a vehicular tire, working on the principle of deriving energy from the fact that a portion of the tire becomes flattened once every revolution, causing a change in the length of the corresponding chord. A small closed magnetic circuit is alternately opened and closed by this movement, by means of a flexible strap coupled between the tire interior and the magnetic circuit. The circuit is reclosed by magnetic attraction.

11215 **High speed variable delivery helical screw compressor/expander automotive air conditioning and waste heat energy recovery system.** Gagnon, J.A.; Schaefer, D.D.; Shaw, D.N. (to Dunham Bush Inc). US Patent 4,220,197. 2 Sep 1980. Filed date 2 Jan 1979. vp.

A compact, helical screw compressor/expander unit is described that is mounted in a vehicle and connected to the vehicle engine driven drive shaft has inlet and outlet ports and a capacity control slide valve and a pressure matching or volume ratio slide valve, respectively, for said ports. A refrigerant loop includes the compressor, a condenser mounted in the path of air flow over the engine and an evaporator mounted in a fresh air/cab return air flow duct for the occupant. Heat pipes thermally connect the cab air flow duct to the engine exhaust system which also bears the vapor boiler. Selectively operated damper valves control the fresh air/cab return air for passage selectively over the evaporator coil and the heat pipes as well as the exhaust gas flow over opposite ends of the heat pipes and the vapor boiler.

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 11172, 11243, 11244, 11251, 11254, 11256, 11257, 11258

11216 (DOE/ET/13335—T1) Application of numerical simulation methodology to automotive combustion. Project status report, October 28-November 24, 1978. (Science Applications, Inc., La Jolla, CA (USA)). 11 Dec 1978. Contract AC03-78ET13335. 34p. NTIS, PC A03/MF A01.

Progress in developing mathematical models to describe combustion conditions with and without swirl in automotive engine combustion chambers and calculations performed with these models are discussed. (LCL)

11217 (DOE/ET/15320—T3) Laboratory evaluation of ceramic coatings for diesel exhaust valves. Final technical report. Scharnweber, D.H.; Vukovich, D.T. (Eaton Corp., Southfield, MI (USA). Engineering and Research Center). Nov 1980. Contract AC03-79ET15320. 77p. NTIS, PC A05/MF A01.

Diesel engine exhaust valves coated with zirconia and calcium silicate ceramic coating systems, developed by the Central Institute for Industrial Research, Oslo, Norway, were laboratory fixture tested to assess bond strength and structural integrity under representative mechanical and thermal stress conditions. The results indicate the zirconia coating systems are worthy of additional evaluation in a medium or high speed industrial/utility diesel engine.

11218 (DOE/NASA/1028—29) Effects of mistuning on bending-torsion flutter and response of a cascade in incompressible flow. Kaza, K.R.V.; Kielb, R.E. (Toledo Univ., OH (USA); National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1981. Contract AI01-76ET20320. 20p. (NASA-TM—81674; CONF-810401—2). NTIS, PC A02/MF A01.

From Structures, structural dynamics and materials conference; Atlanta, GA, USA (Apr 1981).

An investigation of the effects of blade mistuning on the aeroelastic stability and response of a cascade in incompressible flow is reported. The aerodynamic, inertial, and structural coupling between the bending and torsional motions of each blade and the aerodynamic coupling between the blades are included in the formulation. A digital computer program was developed to conduct parametric studies. Results indicate that the mistuning has a beneficial effect on the coupled bending-torsion and uncoupled torsion flutter. The effect of mistuning on forced response, however, may be either beneficial or adverse, depending on the engine order of the forcing function. Additionally, the results illustrate that it may be feasible to utilize mistuning as a passive control to increase flutter speed while maintaining forced response at an acceptable level.

11219 Exhaust gas recirculation for a diesel engine . Sami, H.; Ueda, T. (to Toyota Jidosha Kogyo K K (Japan)). US Patent 4,222,356. 16 Sep 1980. vp.

Disclosed herein is an exhaust gas recirculation control valve for a diesel engine. The valve comprises a valve casing, disposed in the intake line of the engine, of a rectangular cross sectional shape. A valve seat connected to an exhaust line of the engine via an egr passageway is formed in a side wall of the rectangular shaped valve casing. A valve member of a plate shape is arranged in the casing and is rotated about an axis located upstream of the valve seat in such a manner that the valve member is moved between a position wherein the plate closes the valve seat and another position wherein the plate closes the intake passageway. The valve device is operated by an actuator means including a vacuum actuator connected to the valve plate and a vacuum generator which transmits a vacuum signal into the actuator in accordance with the load of the engine.

11220 Engine. Linn, W.L. US Patent 4,222,231. 16 Sep 1980. Filed date 20 Jul 1978. vp.

An engine includes a generally cylindrical housing divided into inlet, combustion chamber, and power housing portions. A shaft is rotatably mounted in the housing. A compressor element is mounted on the shaft for rotation in the inlet portion, an intake and exhaust valve rotor element is mounted on the shaft for rotation in the combustion chamber portion, and a power element is mounted on the shaft for rotation in the power housing. The valve rotor is provided to regulate the flow of compressed air into and out of the combustion chamber. Fuel injection and ignition are suitably timed to occur generally between intake valve closing and exhaust valve opening. Combustion products exit through the exhaust valve into the power rotor. These products rotate the power rotor to drive the compressor and valve rotors. The working surfaces of the compressor and power rotors are helices. The pitch of the compressor rotor helix decreases between the inlet end of the housing and the combustion chamber. The pitch of the power rotor helix increases from the exhaust valve toward an exhaust port. A compressed air storage, or accumulator, portion is provided between the inlet portion and the combustion chamber portion of the housing. A reed valve separates the accumulator from the compressor housing portion to provide a more constant pressure source for the engine at higher operating speed.

11221 Auxiliary lift propulsion system with oversized front fan. Castells, O.T.; Johnson, J.E.; Rundell, D.J. (to General Electric Co). US Patent 4,222,233. 16 Sep 1980. Filed date 2 Aug 1977. vp.

A propulsion system for use primarily in V/STOL aircraft is provided with a variable cycle, double bypass gas turbofan engine and a remote augmenter to produce auxiliary lift. The fan is oversized in air-pumping capability with respect to the cruise flight requirements of the remainder of the engine and a variable area, low pressure turbine is capable of supplying varying amounts of rotational energy to the oversized fan, thereby modulating its speed and pumping capability. During powered lift flight, the variable cycle engine is operated in the single bypass mode with the oversized fan at its maximum pumping capability. In this mode, substantially all of the bypass flow is routed as an auxiliary airstream to the remote augmenter where it is mixed with fuel, burned and exhausted through a vectorable nozzle to produce thrust for lifting. Additional lift is generated by the high energy products of combustion of the variable cycle engine which are further energized in an afterburner and exhausted through a thrust vectorable nozzle at the rear of the engine.

11222 Variable cycle engine. Adamson, A.P.; Sprunger, E.V. (to General Electric Co). US Patent 4,222,235. 16 Sep 1980. Filed date 25 Jul 1977. vp.

A variable cycle turboshaft engine includes a remote fan system and respective high and low pressure systems for selectively driving the fan system in such a manner as to provide VTOL takeoff capability and minimum specific fuel consumption (SFC) at cruise and loiter conditions. For takeoff the fan system is primarily driven by the relatively large low pressure system whose combustor receives the motive fluid from a core bypass duct and, for cruise and loiter conditions, the fan system is driven by both a relatively small high pressure core and the low pressure system with its combustor inoperative. A mixer is disposed downstream of the high pressure system for mixing the relatively cold air from the bypass duct and the relatively hot air from the core prior to its flow to the low pressure turbine.

11223 Corner seal means for rotary piston engines. Kariyama, S.; Nomoto, Y.; Shimizu, K. (to Toyo Kogyo Co Ltd (Japan)). US Patent 4,222,720. 16 Sep 1980. Filed date 22 Aug 1978. vp.

A rotary piston engine is described that has a substantially polygonal rotor provided at each apex portion with an apex seal and corner seals. The corner seal is so arranged that it is forced under the gas pressure introduced in a space behind it toward the side housing. A filler member comprised of a non-rigid material such as a heat resistant rubber or a suitable composite material is provided in a clearance between the corner seal and an adjacent end of the apex seal so as to prevent gas leakage through the clearance.

11224 Internal combustion engine with sustained power stroke. McNair, R.J. (to Avco Corp). US Patent 4,221,198. 9 Sep 1980. Filed date 5 Oct 1978. vp.

A four stroke cycle internal combustion engine is presented having a sustained power stroke which results from a delayed

mixing of a stratified charge. Use of delayed mixing of an overall stoichiometric air-fuel mixture results in formation of a low amount of the oxides of nitrogen. Delayed mixing of the stratified charge is achieved by placement of at least one Helmholtz resonator cavity in the head or closed end of each combustion chamber. The Helmholtz resonator cavity communicates with the top end of the main combustion chamber via a narrow slot. On the intake stroke of each engine cylinder, the main chamber is filled with a slightly fuel rich gaseous charge while the companion Helmholtz resonator cavity is filled with air. During the compression stroke some of the rich air-fuel mixture is forced into the resonator cavity via the communicating slot. At or near tdc, the air-fuel mixture in the main chamber is ignited. As the flame front progresses across the chamber a rapid increase in pressure serves not only to power the piston, but also to initiate a resonant reaction in the Helmholtz resonator cavity which results in a transfer of the unburned gases therein into the main combustion chamber. This both sustains the power stroke and at the same time lowers the peak flame temperature in the main chamber.

11225 **Cross-flow type internal combustion engine with a small sized exhaust gas recirculating system.** Hayashi, Y.; Kamino, H.; Ohnishi, A.; Waku, M. (to Nissan Motor Co Ltd (Japan)). US Patent 4,221,203. 9 Sep 1980. Filed date 16 Jun 1978. vp.

A cylinder head of a cross-flow type internal combustion engine is formed with a through hole or a groove which is associated with an exhaust gas recirculating system to simplify the exhaust gas recirculating system and simultaneously to make it small.

11226 **Internal combustion engine system and operation.** Haas, R.H.; Jackson, H.R. (to Union Oil Co of California). US Patent 4,220,120. 2 Sep 1980. Filed date 14 Dec 1973. vp.

An internal combustion engine operating method and system are described. The system includes provisions for on-site fuel separation, accumulation of the resultant fractions, and an automatic control of engine fuel feed composition and air-to-fuel ratio in response to factors including engine operating temperature, engine load, liquid fuel temperature and ambient conditions. These systems and methods allow dramatic improvement in engine operating performance, hydrocarbon emissions levels, full range fuel characteristics compatible with a given engine and flexibility of operation under varying conditions of load and ambient temperature.

11227 **Fuel vaporizer.** Reynolds, A.L. US Patent 4,220,127. 2 Sep 1980. Filed date 28 Oct 1977. vp.

Air is bubbled through a preset level of fuel in a vaporization chamber, thus forming a vaporized fuel-air mixture. The vaporized fuel-air mixture is supplied to the carburetor through a vapor conduit from the crankcase. Each time the engine is started, a drop of additive is inserted. Each time the engine is stopped the fuel is drained from the vaporization chamber.

11228 **Gas turbine-transmission plant.** Kronogard, S. US Patent 4,220,057. 2 Sep 1980. Filed date 20 Sep 1977. vp.

In an automotive gas turbine power plant including at least one power turbine rotor and a further turbine rotor driving the compressor of the plant, the latter rotor is undersized with respect to the power consumption by the compressor during normal operation and is augmented from the power turbine rotor. The auxiliaries of the power plant are driven from the power turbine rotor, which is connected to the power output shaft, as well as to the compressor turbine rotor by means of a planetary gearing permitting a braking of the output shaft to standstill without the speed of the power turbine rotor being reduced to below that necessary for operating the auxiliaries.

11229 **Optimization of fuel and vehicle parameters. SAE Paper 780589.** Nesmith, T.R. (Amoco Oil Co., Naperville, IL); Tracy, C.B.; Meguerian, G.H.; Keller, B.D.; Daby, E.E. pp 9-19 of Inter-Industry Emission Control Program 2 (IIEC-2). Progress report No. 4. Warrendale, PA; Society of Automotive Engineers, Inc. (1978).

From Passenger car meeting; Troy, MI, USA (5 Jun 1978).

Octane number requirement mapping of an 8:1 CR Ford 2.3 liter engine was carried out under dynamic conditions at 1", 3" and 6" vacuum accelerations. Equations were developed relating octane number requirements to engine rpm, manifold vacuum, spark advance, air-fuel ratio, and exhaust gas recirculation rate. These equations, together with Ford's extensive emissions and fuel consumption data, were used to determine whether octane number requirements constitute a limiting constraint in the optimization of engine-vehicle systems. In addition, steady-state and dynamic octane number requirements were compared at 9:1 CR. The results indicate that dynamic octane number requirements cannot be predicted from limited steady-state requirements data.

11230 **Engine control optimization for smaller passenger cars. SAE Paper 780590.** Matsumoto, K.; Inoue, T.; Nakanishi, K.; Matsushita, S.; Koganemaru, S.; Ooshika, H. (Toyota Motor Co. Ltd., Aichi, Japan). pp 21-37 of Inter-Industry Emission Control Program 2 (IIEC-2). Progress report No. 4. Warrendale, PA; Society of Automotive Engineers, Inc. (1978).

From Passenger car meeting; Troy, MI, USA (5 Jun 1978).

The optimization on an engine-three way catalyst-vehicle system for best fuel economy under the constraints of emissions and driveability, has been studied for a smaller passenger car with 1.6 litter 4 cylinder engine. Full utilization of a computer was intended for the accumulation of basic data and a search for optimum calibration. An automatic Engine Test System (AETS) was developed. The optimum calibration was calculated for the engine-vehicle system with three-way catalyst based on the optimal control theory, and was implemented on an actual vehicle by an engine controller in which a 16 bits microprocessor was used. The results showed good agreement.

11231 **Unregulated emissions from a PROCO engine powered vehicle. SAE Paper 780592.** McKee, D.E.; Ferris, F.C.; Goeboro, R.E. (Ford Motor Co., Dearborn, MI). pp 51-57 of Inter-Industry Emission Control Program 2 (IIEC-2). Progress report No. 4. Warrendale, PA; Society of Automotive Engineers, Inc. (1978).

From Passenger car meeting; Troy, MI, USA (5 Jun 1978).

Unregulated emissions, i.e., emissions which are not currently regulated by EPA, have been measured from a 7.5 L (460 CID) PROCO engine-powered vehicle operating at 50 kph on a chassis dynamometer. A dilution tube was used. Emphasis was on particulate emissions, which were characterized physically and chemically. A comparison is made to recent similar measurements on diesel and conventional gasoline powered vehicles.

11232 **Single-cylinder PROCO engine studies: fuel and engine calibration effects on emissions, fuel economy and octane number requirements. SAE Paper 780593.** Hillyer, B.J. (Mobil Research and Development Corp., Paulsboro, NJ); Wade, W.R. pp 59-77 of Inter-Industry Emission Control Program 2 (IIEC-2). Progress report No. 4. Warrendale, PA; Society of Automotive Engineers, Inc. (1978).

From Passenger car meeting; Troy, MI, USA (5 Jun 1978).

Engine-fuel relationships of the Ford PROCO stratified charge engine were examined. The test program was conducted in 3 phases to assess the interrelationships between exhaust emissions, fuel economy, octane requirement, and fuel properties in an experimental, research, single cylinder, stratified charge PROCO engine. In Phase I, tests were conducted at a steady-state speed-load condition to determine the effect of engine calibration parameters on emissions and fuel economy after an initial evaluation of engine operation with three different ignition system configurations. In Phase II, 5 fuels with significantly different volatility properties and composition were tested to determine their effect on emissions and fuel economy of the PROCO engine. At the same steady-state speed-load condition examined in Phase I, satisfactory operation was obtained at both 0 and 50% EGR with air/fuel ratios as lean as 32:1. None of the fuels tested produced differences in emissions or fuel consumption which could be of practical use. In Phase III, the Primary Reference Fuel (PRF) and Full Boiling Range Unleaded Fuel (FBRU) octane requirements were determined for the single-cylinder PROCO engine at a series of 13 speed-load points which represents both the CVS-H cycle and certain other engine operating conditions. Subsequently, at 6 speed-load points where the PRF octane requirement was above 80, the effects of ignition timing, fuel-injection timing, intake mixture temperature, air/fuel ratio, and

exhaust gas recirculation rates on FBRU octane requirement, exhaust emissions, fuel consumption, and power output were examined. The data show that the best selection of adjustable calibration parameters for controlling octane requirements depends on the mode of engine operation and the emission, fuel economy and performance constraints associated with the mode of operation.

11233 **Atypical fuel volatility effects on driveability, emissions, and fuel economy of stratified charge and conventionally powered vehicles. SAE Paper 780610.** Baudino, J.H.; Copeland, L.C. (Atlantic Richfield Co., Harvey, IL). pp 151-162 of Inter-Industry Emission Control Program 2 (IIEC-2). Progress report No. 4. Warrendale, PA; Society of Automotive Engineers, Inc. (1978).

From Passenger car meeting; Troy, MI, USA (5 Jun 1978).

The effects of fuels having atypical distillation characteristics on the driveability, fuel economy, and emissions of vehicles equipped with a variety of power plants were studied. The power plants included conventional, stratified charge, port fuel injected, and lean-burn engines. The atypical distillation fuels reflect the effect of removing varying amounts of mid-range or front-end blending components from a typical commercial gasoline. An index system was developed which allows a comparison of fuel effects across a fleet of vehicles differing substantially in terms of driveability, fuel economy, and emissions. Using this index system, the fleet average results show that emissions and fuel economy as well as driveability are depreciated with the extreme atypical fuels and that improved driveability can result in improved emissions and fuel economy.

11234 **Fuel volatility effects on driveability of vehicles equipped with current and advanced fuel management systems. SAE Paper 780611.** Morgan, C.R.; Smith, C.N. (Mobil Research and Development Corp., Paulsboro, NJ). pp 163-171 of Inter-Industry Emission Control Program 2 (IIEC-2). Progress report No. 4. Warrendale, PA; Society of Automotive Engineers, Inc. (1978).

From Passenger car meeting; Troy, MI, USA (5 Jun 1978).

Fuel volatility and cold/hot engine driveability relationships were evaluated in six 1976/1977 model cars representing conventional carburetor and advanced type fuel metering systems. The program objective was to provide guidance for engine modifications to take advantage of fuel benefits or to overcome performance deficiencies. There were large variations among cars in the maximum volatility tolerance relative to vapor lock during summer, hot engine operation, with a fuel-injected and a new design carburetor system tolerating gasoline volatility levels in excess of normal maximum summer levels. Similarly, cold engine start and driveaway performance at low and intermediate ambient conditions varied widely. Fuel-injected cars showed the best performance and least sensitivity to gasoline volatility changes. Performance differences among all cars with a specific fuel were significantly greater than differences resulting from typical variations of fuel volatility for individual cars. This shows that fuel systems can be designed to provide good overall driveability performance and wide tolerance in fuel volatility, permitting greater flexibility to produce unleaded gasoline.

11235 **Influence of fuel characteristics on vaporization in the S.I. engine cylinder during cranking at low temperature. SAE Paper 780612.** Nakajima, Y.; Saito, T.; Takagi, Y.; Katoh, K.; Lijima, T. (Nissan Motor Co., Ltd., Yokosuka, Japan). pp 173-189 of Inter-Industry Emission Control Program 2 (IIEC-2). Progress report No. 4. Warrendale, PA; Society of Automotive Engineers, Inc. (1978).

From Passenger car meeting; Troy, MI, USA (5 Jun 1978).

Using five single-component, three dual-component and five full boiling range fuels, the relationship between engine startability under low temperature and fuel volatility was experimentally studied. The study was carried out through the analysis of fuel vaporization and mixture formation in the cylinder. The effect of other factors such as cranking speed, ignition timing and fuel quantity supplied to the cylinder on startability was also examined from the view point of fuel vaporization in the cylinder. A theoretical approach for estimating the startability with fuels of various volatility was attempted. Based on this estimation, the degree of cold startability deterioration with lower volatility fuels and the way to improve cold engine startability were discussed.

11236 **Wetting the appetite of spark ignition engines for lean combustion. SAE Paper 780234.** Peters, B.D.; Quader, A.A. Warrendale, PA; Society of Automotive Engineers, Inc. (1978). 25p. (CONF-780208—118).

From Society of Automotive Engineers International Automotive Engineering Congress and Exposition; Detroit, MI, USA (Feb 1978).

Single-cylinder spark ignition engine experiments conducted at constant speed, fixed airflow, and using isooctane as the fuel, demonstrated the effects of fuel-air mixture preparation on lean operation. Mixture preparation was changed by varying the time of fuel injection in the induction manifold, near the intake valve port. For comparison, a prevaporized fuel-air mixture was also investigated. Emphasis was placed on determining the effects of mixture preparation on combustion characteristics. Based on the results from this study, the often favored prevaporized mixture of fuel and air may not be the best diet for lean engine operation.

3303 Electric-powered Systems

11237 (CONF-8009108—, pp 92-102) **Electric and hybrid vehicle program.** Brown, P. 1980.

From Alternate sources of energy conference; New York, NY, USA (29 Sep 1980).

Programs in the USA for demonstrating the performance of electric-powered vehicles for private and commercial use are reviewed with information on vehicle conversions, costs, maintenance, acceleration, range, batteries, regenerative braking using flywheels, and hybrid ICE-electric units. (LCL)

11238 **(DOE/TIC—11373) Change-of-pace electric automobile user demonstration (COMCAR II). Final report.** Johnson, K.E. (Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy Center). Nov 1980. Contract EC-77-X-01-3559. 75p. NTIS, PC A04/MF A01.

The ComCar II project is designed as a user demonstration project of a present-technology electric car. The goal, therefore, was to test the car under conditions which were as close as possible to real life conditions, as opposed to the laboratory conditions encountered on the dynamometer or the test track. The test program was conducted over several months, so that the data would realistically reflect the performance characteristics of the car under urban driving conditions. In addition to demonstrating the Change-of-Pace, the ComCar II project was expected to make contributions toward product improvement. Engineering evaluations of car components were performed in close cooperation with the manufacturer, in an effort to help solve several technical problems which were encountered. Information was obtained and is presented on vehicle performance, operating costs, drivers' responses to electric vehicles, and the support structures need to operate and maintain electric vehicles. (LCL)

11239 **Electrical drive for automobile.** Fobbs, H. US Patent 4,222,450. 16 Sep 1980. Filed date 13 Apr 1978. vp.

Electrical apparatus for driving an automobile is described that is comprised of a dc motor operationally connected to the rear axle through a drive shaft with the motor energized from storage batteries and recharged from alternators coupled to the drive shaft adjacent a clutch at the rear end of the automobile through an auxiliary drive shaft.

11240 **Electrical vehicle traction equipment.** Aronsson, O.; Frank, K.; Friden, L. (to ASEA Ab (Sweden)). US Patent 4,220,902. 2 Sep 1980. Filed date 20 Sep 1978. vp.

An improved traction apparatus for electrical vehicles is described that is supplied with energy over a contact line and that utilize a filter capacitor to smooth the input current to a dc convertor that is used to energize a driving motor. The improvement concerns means for avoiding surges of filter capacitor charging current when the line voltage rises after a line voltage drop. A thyristor is used to pass current to the convertor when the line voltage remains within a particular operational range and to block the flow of cur-

rent to direct the current to a current limiting resistor when the line voltage begins to rise after a short duration or relatively longer duration voltage drop.

11241 Electric vehicles in the Tennessee Valley. Barnett, J.H. (Tennessee Valley Authority, Chattanooga). pp 329-332 of Nonpetroleum vehicular fuels: symposium papers. Chicago, IL; Institute of Gas Technology (1980).

From Symposium on nonpetroleum vehicular fuels; Arlington, VA, USA (11 Feb 1980).

The Tennessee Valley Authority (TVA) in the past has evaluated several electric vehicles (EV's) at TVA facilities and is presently testing, evaluating, and demonstrating EV's through cooperative projects with the Electric Power Research Institute (EPRI) and the United States Department of Energy (DOE) and through a continuation of TVA's own evaluation efforts. The EPRI/TVA project will evaluate state of the art EV's and determine the impacts of widespread battery recharging on electric power generation systems. Twenty large van-type vehicles will operate on designated routes with known profiles and traffic patterns. Real time operating data will be obtained to evaluate component and system efficiencies during this two-year project. TVA is also cooperating in a project with the DOE Electric and Hybird Vehicle Product Engineering Branch. Under phase I of the project reliability tests of improved EV's developed in the DOE 2 x 4 improved EV program will be conducted and assistance will be provided to EV vendors to correct potential problems before the vehicles enter DOE's commercialization program. Phase II of this project will include testing of several vehicles with advanced propulsion systems. The TVA program will evaluate vehicles not included in either of the above projects.

3304 Hybrid Systems

REFER ALSO TO CITATION(S) 11237, 11245

11242 (CONF-800334—(Vol.2), pp 650-664) **Potential of electric and hybrid vehicles.** Hamilton, W. (General Research Corp., Santa Barbara, CA). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

A technology assessment of EHV's currently under way focuses on impacts of the introduction of these new technologies into the environment. While electric cars are highly desirable for conservation and the environment, their probable sales, use, and total beneficial impacts are limited because their ranges will be insufficient for many applications, even with improved batteries and technology. The range-extension hybrid configuration considered here removes this drawback by replacing part of the propulsion battery with a small internal-combustion engine sized for highway cruising. Urban operation, however, would remain all-electric. If all future personal cars were range-extension hybrids, their petroleum consumption would be reduced by 67 to 74%, nearly as much as if they were pure electrics. Impacts on urban air pollution and traffic noise of the hybrids would be only slightly less favorable than those for all-electric cars. Overall, the range-extension hybrid removes the principal obstacle to general use electric vehicles, limited range, but preserves the benefits of electric drive for conservation and the environment in urban areas.

11243 (CONF-801022—(Suppl.1), pp 48-56) **Fuel economy potential of heat engine/flywheel hybrid automobiles.** Rhode, S.M. (General Motors Research Labs., Warren, MI). 1980.

From Flywheel technology symposium; Scottsdale, AZ, USA (19 Oct 1980).

Starting with the tractive energy requirements of automobiles over the EPA driving schedules, bounds for the fuel economy potential of idealized heat engine/flywheel hybrid vehicles were established as functions of vehicle mass and driveline efficiency. These bounds were compared with current production vehicle fuel economies and substantial fuel economy potential was noted. When the vehicle is penalized for the initial flywheel charge energy, the potential economy gains are reduced. The initial charging energy should be accounted for when comparing hybrids to conventional powerplants.

11244 (CONF-801022—(Suppl.1), pp 68-80) **Low cost, high performance, dual mode car.** Rabenhorst, D.W. (John Hopkins Univ., Laurel, MD). 1980.

From Flywheel technology symposium; Scottsdale, AZ, USA (19 Oct 1980).

An engine/flywheel car is presented in conceptual form and its probable fuel economy calculated. The most important feature of this concept is that it uses a flywheel of sufficiently large energy storage capacity that the car's performance is dominated by the flywheel and drive train characteristics. The engine is effectively decoupled from the drive train and serves only to recharge the flywheel. This is, then, an engine augmented, flywheel-driven car in contrast to similar devices using smaller flywheels which may more properly be described as flywheel augmented, engine-driven cars. The resulting car has a fuel utilization comparable to that of a battery/engine hybrid car and an acceleration capability competitive with conventional engine driven cars. Calculated fuel use characteristics of a 2500 lb car with realistic losses are given. In summary, a 48.5 mile/gal fuel mileage in the highway driving cycle (55 mph) and a 61 mile/gal mileage in the urgan cycle (30 mph) are predicted. Development work needed on components, particularly the flywheel and CVT, is discussed with an emphasis on work needed to support the implementation of the concept described in the text.

3305 Flywheel Propulsion

11245 (CONF-801022—(Suppl.1), pp 40-47) **Flywheel automobile marketability: an overview.** Adolfson, W.F. (Advanced Technology, Inc., McLean, VA). 1980.

From Flywheel technology symposium; Scottsdale, AZ, USA (19 Oct 1980).

Flywheels are a new option for the automobile industry to reduce consumption of liquid petroleum fuels. However, a functional and marketable vehicle utilizing a flywheel energy storage system will not be commercially available until technology development places more emphasis on a design based on market requirements rather than technical achievement. Given the technical feasibility of the concept of utilizing flywheels for transportation applications, the key market issues affecting the commercialization of flywheel energy storage technology are reviewed. Examination indicates that the major challenges will be to solve technical and economic uncertainties involving composite behavior, transmissions, safety and reliability; to define market needs; and to encourage private industry investment.

3306 Vehicle Design Factors

REFER ALSO TO CITATION(S) 11221, 11222, 11228

11246 (DOE/NASA/0124—5) Small passenger car transmission. Final report test: Dodge Omni A-404 transmission. Bujold, M.P. (Eaton Corp., Southfield, MI (USA). Engineering and Research Center). Sep 1980. Contract AI01-77CS51044. 356p. (NASA-CR—165181; ERC-LIB—80173). NTIS, PC A16/MF A01.

The small passenger car transmission test was initiated to supply electric vehicle manufacturers with technical information regarding the performance of commercially available transmissions. This information would enable EV manufacturers to design a more energy efficient vehicle. With this information the manufacturers would be able to estimate vehicle driving range as well as speed and torque requirements for specific road load performance characteristics. The testing of a 1979 Dodge Omni A-404 automatic transmission is discussed. This transmission was tested in accordance with a passenger car automatic transmission test code (SAE J65lb) which required drive performance, coast performance, and no load test conditions. Under these test conditions, the transmission attained maximum efficiencies in the mid-eighty percent range for both drive performance test and coast performance tests. The major results of this test are the torque, speed and efficiency curves which are presented. These graphs map the complete performance characteristics for the Dodge Omni A-404 transmission.

3307 Emission Control

11247 Analytical study of nitrogen oxides and carbon monoxide emissions in hydrocarbon combustion with added nitrogen--preliminary results. Bittker, D.A. (NASA, Lewis Res Cent, Cleveland, Ohio). *American Society of Mechanical Engineers, [Paper] ;* No. 80-GT-60, vp(1980).

This work is one part of a four-part Critical Research and Technology Fuels Combustion Program funded by the Department of Energy. The primary objective of this part of the program is to analytically determine the effect of combustor operating conditions on the conversion of fuel-bound nitrogen (FBN) to nitrogen oxides. The effect of FBN and of operating conditions on carbon monoxide (CO) formation was also studied. 19 refs.

11248 Exhaust gas recirculation apparatus for an internal combustion engine. Abe, T.; Hasegawa, Y.; Kawai, N.; Ota, I.; Yamamoto, H.; Yamasaki, T. (to Nippondenso Co Ltd Jp; Toyota Jidosha Kogyo K K (Japan)). US Patent 4,222,355. 16 Sep 1980. vp.

Disclosed herein is an internal combustion engine provided with an exhaust gas recirculation system of so-called back pressure control type. The exhaust gas recirculation system is provided with a vacuum line connecting a so-called EGR port with a vacuum operated flow control valve, and a modulator valve having a control chamber selectively opened to the vacuum line in response to the pressure of recirculated exhaust gas for controlling vacuum signal level of the flow control valve. The control chamber of the modulator is connected to another vacuum signal port located slightly above the EGR port.

11249 Exhaust gas recirculation system for an internal combustion engine. Abe, T.; Ota, I. (to Nippondenso Co Ltd Japan; Toyota Jidosha Kogyo K K (Japan)). US Patent 4,222,357. 16 Sep 1980. vp.

Disclosed herein is a back pressure control type EGR system for an internal combustion engine, wherein a vacuum modulator has an air introducing chamber which is selectively opened, in accordance with the pressure of recirculated exhaust gas, to a vacuum line connecting an EGR port with a vacuum operated flow control valve. The air introducing chamber is further connected to another vacuum port formed slightly above the EGR port via another vacuum line. Switching valve devices responsive to the temperature of the engine are located on the vacuum lines for stopping the EGR operation when the engine is cold.

11250 Exhaust gas purifying apparatus for internal combustion engine. Kohama, T.; Nohira, H.; Obayashi, H.; Ozaki, T. (to Nippon Soken Inc (Japan); Toyota Jidosha Kogyo K K (Japan)). US Patent 4,222,237. 16 Sep 1980. Filed date 25 Aug 1978. vp.

An exhaust gas purifying apparatus for an internal combustion engine is described. The device has an intake conduit for supplying airfuel mixture to the engine, an exhaust conduit for conducting exhaust gas discharged from the engine to a catalyst for purifying the exhaust gas, secondary air supply pump driven by the engine for supplying secondary air to the exhaust conduit and detector for detecting oxygen content of the exhaust gas. The negative pressure in the intake conduit is compared with the differential pressure produced across a restriction disposed in the secondary air supply conduit thereby to control the quantity of the secondary air supply so as to be proportional to the quantity of the intake in dependence on the result of the comparison. The output signal of the oxygen detector is utilized for modifying the above control.

11251 Method and apparatus for reducing nitrous oxide emissions from combustors. Robinson, R.L. (to United Technologies Corp). US Patent 4,222,232. 16 Sep 1980. Filed date 19 Jan 1978. vp.

An improved combustor for a gas turbine engine is disclosed. Techniques for reducing the level of noxious pollutants emitted by the combustor are developed. In one embodiment, a combination of serpentine geometried, fuel-mixing tubes discharging to the radially outward area of the combustor and an axially oriented, fuel-mixing tube near the center of the combustor are adapted to generate a strong centrifugal force field within the combustor by swirling the fuel/air mixtures flowing therethrough. The force field promotes rapid mixing and combustion within the chamber to reduce both the magnitude of the combustor temperature and the period of exposure of the medium gases to that temperature. The tube at the center of the combustor is adapted to swirl the medium flowing therefrom in a circumferential direction counter to the direction in which the medium from the serpentine geometried tubes is swirled. In accordance with the method taught, the fuel/air ratio in the serpentine mixing tubes is maintained within the range of fifty to seventy-five percent (50-75%) of the stoichiometric fuel/air ratio for the fuel employed and the fuel/air ratio in the axial mixing tube is maintained at a value less than seventy-five percent (75%) of the stoichiometric fuel/air ratio for the fuel employed.

11252 Method for reducing CO and HC emissions. Baron, K.; Hegedus, L.; Oh, S.H. (to General Motors Corp). US Patent 4,222,236. 16 Sep 1980. Filed date 19 Jun 1978. vp.

A method is described for decreasing CO and HC emissions in a vehicle exhaust stream during the period of engine warm-up following the start of engine operation, in which the A/F mixture to the engine is pulsed by first using a mixture which is leaner than that otherwise used thus reducing the CO and HC content of the exhaust stream exiting the engine to an amount below that of the CO and HC otherwise present and then using an A/F mixture which is richer than such lean mixture and is substantially that otherwise used thus increasing the amount of CO and HC in the vehicle exhaust stream to substantially the amount otherwise present, passing the pulsed exhaust stream through a catalytic converter adapted to oxidize the CO and HC constituents, and repeating this pulsing continuously through the period of engine warm-up and at a rate sufficient to achieve increased catalytic conversion of CO and HC over that obtained without pulsing, the rate being also sufficiently rapid so as to preclude engine-stall. A preferred system for practicing the method involves apparatus for the repeated opening of the choke plate of the engine carburetor during the period when the choke plate is not full-open.

11253 Exhaust gas control equipment. Iwaoka, K.; Toh, T. (to Matsushita Electric Industrial Co Ltd (Japan)). US Patent 4,220,625. 2 Sep 1980. Filed date 5 Jun 1979. vp.

An exhaust gas purifier for purifying combustion gases of engines is described. The device is comprised of at least one composite sheet which is formed by sandwiching a catalyst coated sheet of cloth between a pair of supporting nets of heat resistive metal, the composite sheet being disposed in an exhaust pipe in a manner such that the exhaust gas flows in the direction of and along the surfaces of the composite sheet and that the gas contacts the catalyst sheet through the supporting net. The composite sheet(s) are shaped or disposed in a rolled sheet with spacer means to form gas flow path between its layers, or a set of coaxial tubes of the composite sheet disposed with spaces for gas-flow, or a set of parallel-disposed flat composite sheets with spaces for gas-flow. The device is advantageous in low resistivity for the gas flow.

11254 Inter-Industry Emission Control Program 2 (IIEC-2). Progress report No. 4. Warrendale, PA; Society of Automotive Engineers, Inc. (1978). 192p. (SP—431; CONF-780683—(Exc)).

From Passenger car meeting; Troy, MI, USA (5 Jun 1978).

Fourteen papers were pesented at the meeting. A separate abstract was prepared for each paper. (LCL)

11255 Inter-Industry Emission Control Program: eleven years of progress in automotive emissions and fuel economy research. SAE Paper 780588. McCabe, L.J.; Koehl, W.J. pp 1-8 of Inter-Industry Emission Control Program 2 (IIEC-2). Progress report No. 4. Warrendale, PA; Society of Automotive Engineers, Inc. (1978).

From Passenger car meeting; Troy, MI, USA (5 Jun 1978).

11256 **Evaluation of three-way catalysts. Part III. Formation of NH_3, its suppression by SO_2 and re-oxidation. SAE Paper 780606.** Gandhi, H.S.; Yao, H.C.; Stepien, H.K.; Shelef, M. (Ford Motor Co., Dearborn, MI). pp 107-118 of Inter-Industry Emission Control Program 2 (IIEC-2). Progress report No. 4. Warrendale, PA; Society of Automotive Engineers, Inc. (1978).

From Passenger car meeting; Troy, MI, USA (5 Jun 1978).

A laboratory evaluation of three-way catalysts is presented. The effect of inlet NO concentration and temperature on the NH_3 formation over fresh, pulsator-aged and dynamometer-aged three-way catalysts of the current generation has been investigated under temperatures and exhaust compositions of practical interest. In site of differences in aging procedures employed, both the pulsator and dynamometer-aged catalysts show similar selectivity behavior. The effect of SO_2 in feed-gas on gross NO conversion and NH_3 formation was studied over Pt-Rh and Pt-Rh-Ru types of three-way catalysts. A strong dependence of the gross NO conversion on the SO_2 concentration in exhaust gas mixtures was noted. A simultaneous suppression of gross NO conversion and NH_3 formation, in presence of SO_2 in feed-gas, is attributed to the poisoning of Pt sites on aged three-way catalysts. IR studies of SO_2 and CO adsorption over Pt, Rh and Ru metals suggest that differences in the surface affinity of these metals to SO_2 can be related to their observed activity patterns. Finally, reoxidation of NH_3 (formed over three-way catalysts) on the vehicle-aged oxidation catalyst was studied as a function of catalyst temperature, excess oxygen and inlet NH_3/NO ratio.

11257 **Effect of air-fuel ratio modulation on conversion efficiency of three-way catalysts. SAE Paper 780607.** Kaneko, Y.; Kobayashi, H.; Komagome, R.; Hirako, O.; Nakayama, O. (Mitsubishi Motors Corp., Tokyo, Japan). pp 119-127 of Inter-Industry Emission Control Program 2 (IIEC-2). Progress report No. 4. Warrendale, PA; Society of Automotive Engineers, Inc. (1978).

From Passenger car meeting; Troy, MI, USA (5 Jun 1978).

The widening of the selectivity windows of a three-way catalyst under A/F ratio modulation was shown to result from retention of adsorbed species on catalyst surfaces and their subsequent reaction with gas-phase reactants. A reaction model was developed based on adsorption properties of CO, HC and NO/sub x/ and by computer simulation, the conversion efficiencies of CO, HC and NO/sub x/ under A/F ratio modulation were calculated. The calculated and experimental results were in good agreement.

11258 **50,000 mile vehicle road test of three-way and NO/sub x/ reduction catalyst systems. SAE Paper 780608.** Wotring, W.T. (Standard Oil Co., Cleveland, OH); Meguerian, G.H.; Gandhi, H.S.; McCuiston, F.D.; Piken, A.G. pp 129-150 of Inter-Industry Emission Control Program 2 (IIEC-2). Progress report No. 4. Warrendale, PA; Society of Automotive Engineers, Inc. (1978).

From Passenger car meeting; Troy, MI, USA (5 Jun 1978).

The performance of three way and NO/sub x/ catalysts was evaluated on vehicles utilizing non-feedback fuel control and electronic feedback fuel control. The vehicles accumulated 80,450 km (50,000 miles) using fuels representing the extremes in hydrogen-carbon ratio available for commercial use. Feedback carburetion compared to non-feedback carburetion improved highway fuel economy by about 0.4 km/l (1 mpg) and reduced deterioration of NO/sub x/ with mileage accumulation. NO/sub x/ emissions were higher with the low H/C fuel in the three way catalyst system; feedback reduced the fuel effect on NO/sub x/ in these cars by improving conversion efficiency with the low H/C fuel. Feedback had no measureable effect on HC and CO catalyst efficiency. Hydrocarbon emissions were lower with the low H/C fuel in all cars. Unleaded gasoline octane improver, MMT, at 0.015g Mn/l (0.06 g/gal) increased tailpipe hydrocarbon emissions by 0.05 g/km (0.08 g/mile).

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 10417, 10428

11259 **(CONF-800891—) Proceedings of conference on fleet use of unique automotive fuels.** (Southwest Research Inst., San Antonio, TX (USA)). 1980. Contract AC01-78CS54269. 225p. (MED—117). NTIS, PC A10/MF A01.

From Conference on fleet use of unique automotive fuels; San Antonio, TX, USA (13 Aug 1980).

Papers and/or summaries of presentations which were given at the conference are included in this volume. The conference was concerned with alcohol and emergency fuels. Topics covered include: ethanol supply; Texaco lead-free gasohol distribution; the BETC fleet test program; the army fleet test program; tri-butyl alcohol and methanol in gasoline (blending, distribution, utilization); the DOE alcohol fuels utilization program; DOE engineering and reliability fleet test results; federal emergency energy policy; emergency transportation resource management; EPA emergency action; DOE transportation emergency fuels program; and emergency fuels utilization guidebook. Summaries of the 2 panel discussions are also included. Separate abstracts of 5 papers have been prepared for inclusion in the Energy Data Base. There are 10 summaries in this document which have not been abstracted separately. (DMC)

11260 (CONF-800891—, pp 51-63) **Review of the US Department of Energy project for reliability fleet testing of alcohol/gasoline blends.** Raymond, R.D. (Aerospace Corp., Germantown, MD); Tosh, J.D. 1980.

From Conference on fleet use of unique automotive fuels; San Antonio, TX, USA (13 Aug 1980).

11261 (CONF-800891—, pp B.3-B.53) **Project plan for reliability fleet testing of alcohol/gasoline blends.** (Aerospace Corp., Germantown, MD). 1980.

From Conference on fleet use of unique automotive fuels; San Antonio, TX, USA (13 Aug 1980).

The Alternative Fuels Utilization Program (AFUP) addresses several options as petroleum replacements for highway vehicles. At this time, the AFUP effort is concentrating on alcohol fuels, with the goal of bringing the end-use technology for alcohol/gasoline blends to the point of commercial readiness by 1982-1983 and straight alcohol fuels to this position by 1985. The project described herein is the last step in achieving this state of readiness for the alcohol/gasoline blends. It addresses fuels and vehicles representative of what industry would most likely provide if alcohol/gasoline blends significantly penetrate the US market. These fuels will be formulated or engineered for maximum performance and compatibility, thereby differing from gasohol which is a simple mixture of ethanol and available unleaded gasoline. Vehicles will be designed to effectively and reliably utilize these fuels. The goals, scope, and general approach for the project are defined. The implementation strategy, test planning guidelines, financial requirements, legal and institutional requirements, management controls, and schedule charts for the test project are presented.

11262 **Systems overview of new automotive fuels.** Ecklund, E.E. (Dept. of Energy, Washington, DC). pp 15-28 of Nonpetroleum vehicular fuels: symposium papers. Chicago, IL; Institute of Gas Technology (1980).

From Symposium on nonpetroleum vehicular fuels; Arlington, VA, USA (11 Feb 1980).

Energy development, assessments and program concerns over the past five years have moved the state of the art form an era of generalizations into one of addressing secondary and tertiary factors and intricate interactions between resource, process, fuel, combustor and various socio-economic effects. Although systems aspects have been discussed and addressed, they have not been afforded the level of attenuation necessary to fully appreciate the ramifications of various options or to move into commercialization thereof. This presentation delineates key factors in a variety of areas which in turn must be pulled together to define any given option. This will also hopefully provide perspective for your consideration of the specifics that will be presented by others in the more detailed discussions which follow.

11263 **New fuels R and D target: the engine/fuel couple.** Hurn, R.W. (Bartlesville Energy Technology Center, OK). pp 59-66 of Nonpetroleum vehicular fuels: symposium papers. Chicago, IL; Institute of Gas Technology (1980).

From Symposium on nonpetroleum vehicular fuels; Arlington, VA, USA (11 Feb 1980).

Interest in alternative fuels is high, and it is widely assumed that new and different fuels soon will appear in the marketplace. Demands are being made that specifications be put upon the new fuels so that engines can be designed for them. The author takes a contrary viewpoint and suggests an alternate R and D strategy. First, new fuels will come later than soon - with significant quantities of coal or shale-derived fuels becoming available only after the turn of the century. To specify properties for these fuels at this point in time will preempt technical options that should be left open. Alternatively, information is needed from experimental work with possible or probable fuels used in compatible engines that offer plausible design options. Only after these engineering data are available can there be sound choices of engineering options concerning both the fuels that are to be made and the engines in which they will be used. The author thus identifies the engine/fuel couple as a priority R and D target in future research that will support alternative fuels development.

36 MATERIALS

11264 **(DOE/ER/01198—1335) Science of materials. Progress report, January 1-December 31, 1979.** (Illinois Univ., Urbana (USA). Materials Research Lab.). 1979. Contract AC02-76ER01198. 160p. NTIS, PC A08/MF A01.

The research program includes studies of the microchemistry, microstructure, deformation, corrosion and fracture of metals, ceramics and alloy materials, of the hydrogen embrittlement of metals, the mechanism of heat transfer across interfacts, catalytic properties of surfaces, and erosion of surfaces by fluid suspended particles. The structure of liquids, polymers and disordered solids is under investigation with emphasis on molecular interactions and bonding, on ionic conduction, phase transitions and radiation damage. Ferro- and pyro-electric materials with potential for solar energy applications are under development. The study of optical properties includes the mechanism of luminescence, the design of molecular photoreceptors, and new semiconductor materials for photovoltaic devices.

3601 Metals And Alloys

11265 **(DOE/ER/01198—1337) Quadrupole interactions in molybdenum base dilute binary vanadium and niobium alloys.** Chou, L.H. (Illinois Univ., Urbana (USA)). 1981. Contract AC02-76ER01198. 47p. NTIS, PC A03/MF A01.

Thesis.

The ^{95}Mo resonance in pure Mo after filing and annealing near 1000°C consists entirely of the m = 1/2 → -1/2 transition. Decreased absorption intensity and line broadening caused by solute addition can be understood as a direct result of second order perturbation of the m = 1/2 → -1/2 transition. A/h for ^{95}Mo is roughly 200 Hz for nuclei near either V or Nb in Mo. The data establish the magnitude and the mechanism of the broadening observed in ^{95}Mo when V and Nb are present as minor alloying elements (0 to 10 at. %).

11266 **(DOE/ER/01198—1338) Oxygen diffusion in vanadium-based alloys.** de Avillez, R.R. (Illinois Univ., Urbana (USA). Dept. of Metallurgy and Mining Engineering). 1981. Contract AC02-76ER01198. 114p. NTIS, PC A06/MF A01.

Thesis.

The experimental study of transport and equilibrium properties of oxygen in vanadium-based alloys was made by EMF measurements on solid electrolytic cells over the temperature range of 873 to 1423°K. The oxygen diffusion in vanadium was not significantly modified by small additions of Ti, Cr, Ni, Nb and Ta. The increase in the activation energy for oxygen diffusion in the V-based alloys containing Cr, Ni, Nb and Ta probably reflects the effect of these substitutional solutes on the activity coefficient of oxygen. The oxygen activity was increased by the addition of 1 at % of Cr, Ni and Nb, and decreased by the addition of Ti and Ta. However, the effects in the alloys containing Nb and Ta are very small.

11267 **(DOE/ER/03518—96) Defects in metal crystals. Progress report, May 1, 1980-April 30, 1981.** Seidman, D.N. (Cornell Univ., Ithaca, NY (USA)). Jan 1981. Contract AS02-76ER03158. 102p. NTIS, PC A06/MF A01.

During the past year a strong endeavor was made to redirect the efforts of the research group to determine atomic mechanisms for the formation of metal silicides, among other problems, produced as a result of: (a) ion or electron irradiation of metal-silicon sandwiches; and (b) the ion irradiation of subsaturated binary alloys containing silicon. In addition, an appreciable component of the research is aimed at understanding the atomic mechanisms responsible for radiation-induced segregation and RIP in a wide range of fast-neutron irradiated refractory metals and alloys. In these same neutron irradiated specimens a search is being made for the species that are responsible for the nucleation of voids. In particular, the voids are being examined, by the atom-probe field-ion microscope technique, for the interstitial impurities helium, carbon, nitrogen and oxygen. Evidence was obtained for the presence of carbon in a void of a fast neutron-irradiated molybdenum (titanium) alloy.

11268 **(DOE/ER/70013—T1) Thermal stability of ferritic alloys for fossil-fuel processing systems.** Polonis, D.H. (Washington Univ., Seattle (USA). Dept. of Mining and Metallurgical and Ceramic Engineering). 31 Mar 1980. Contract AT06-76ER70013. 3p. NTIS, PC A02/MF A01.

Portions of document are illegible.

The program is concentrated on the kinetics and severity of the 475°C embrittling reaction in Fe-Cr alloys containing varying amounts of ternary elements: the present studies are concerned with the effects of small amounts of aluminum.

11269 **(DOE/ET/12313—T2) Characterizing and improving the toughness of thick-sectioned 2-1/4 Cr-1 Mo electroslag weldments. Quarterly report, October-December 1980.** Edwards, G.R.; Frost, R.H. (Colorado School of Mines, Golden (USA). Dept. of Metallurgial Engineering). 1980. Contract AS05-78ET12313. 23p. NTIS, PC A02/MF A01.

Effects of electrochemical reactions on electroslag welds of 2-1/4 Cr-1 Mo steel were evaluated using a CaF_2-10% Al_2O_3 flux. Results indicate that a major fraction of the chemical modification observed in the dc electroslag welding process can be attributed to electrochemical reactions, which offer the possibility for enhanced control of the chemistry of the fusion zone. 11 figures. (DLC)

11270 **(DOE/ET/13513—T6) Contract WEC 3.2.3 study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement. Quarterly report No. 8, May 15-August 15, 1980. Embrittlement of Cr-Mo steels in H_2S plus H_2O vapor environment.** Shaw, B.J. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 28 Nov 1980. Contract AC05-78ET13513. 22p. NTIS, PC A02/MF A01.

The H_2S + H_2O vapor environment tests appear to yield data which is within the normal experimental scatter and serves to reasonably differentiate between the hydrogen resistance of candidate steel samples. A potential problem stemming from the deep side grooves, which promote advanced crack growth in the higher strength steels, can be overcome by reducing the side grooves to 25%. This is the optimum side groove depth recommended by deLorenzi and Shih.

11271 **(DOE/ET/13711—T1) Thermal stability of ferritic alloys for fossil fuel processing systems.** Polonis, D.H. (Washington Univ., Seattle (USA). Dept. of Mining and Metallurgical and Ceramic Engineering). 31 Oct 1980. Contract FG01-78ET13711. 6p. NTIS, PC A02/MF A01.

Experimental work within the period was concentrated on the application of refined electrical resistance measurements and analytical techniques to quantify the thermal instability of ternary Fe-Cr-Al alloys as a function of alloy composition and temperature. The aging reactions are being examined over the temperature range where 475°C embrittlement is of concern in commercial ferritic stainless steels of similar Cr contents.

11272 **(DOE/OR/10244—10) Electron beam welding of 8-inch thick 2-1/4 Cr-1 Mo. Final report.** Weber, C.M. (Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div.). Aug 1980. Contract AC05-77OR10244. 173p. NTIS, PC A08/MF A01.

Electron beam welding procedures were developed and used to make sound welds in 8-inch thick 2-1/4 Cr-1 Mo in the horizontal position. A two-pass technique, one pass from each side, was developed for welding the 8-inch thickness. Techniques for eliminating various weld defects were developed. It was learned that the beam oscillation conditions strongly influenced welding performance. Procedures were developed for hard and soft vacuum operation, but hard vacuum was preferred. Procedures for starting and stopping the welding sequence were developed, along with a repair technique involving re-welding over a plug filled hole. The joint fit-up requirements were determined: a joint mismatch of 3/4 in. was welded, and a joint gap opening of 0.100 in. was welded without alteration of the welding procedure. It was shown that it is not necessary to demagnetize the material for successful welding, but that a special magnetic shield may be needed to protect the electron beam from stray magnetic fields. A demonstration weld failed to meet the NDE requirements of the ASME Boiler and Pressure Vessel Code due to poor base metal quality which adversely affected weld performance. The mechanical properties (hardness, strength, ductility, and impact), and the microstructure of electron beam welded 8-inch thick SA387 Grade 22 Class 2 were determined and appeared to be adequate.

11273 **(DPSPU—80-30-5) High current resistance welding for capsule closure.** Kanne, W.R. Jr.; Kelker, J.W. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Mar 1980. Contract AC09-76SR00001. 17p. (CONF-800462—2). NTIS, PC A02/MF A01.

From 61. annual meeting of the American Welding Society; Los Angeles, CA, USA (14 Apr 1980).

Solid-state resistance upset welding is a fast and reliable method for producing high integrity closures in capsules of common alloys and alloys unweldable by fusion welding methods.

11274 **(HEDL—6883) Correlation of irradiation effects data using primary recoil spectra.** Simons, R.L. (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1980. Contract AC14-76FF02170. 41p. NTIS, PC A03/MF A01.

The objective of this work is to extend the knowledge of the energy dependence of damage by making use of available charged particle data. This is done by applying the damage function analysis method to deduce the primary recoil energy dependence of charged particle and neutron irradiation effects data. Primary recoil damage functions for production of Frenkel pairs in copper, silver, molybdenum, and tungsten were deduced from changes in resistivity after irradiation with neutron or charged particles and from computer simulation data on displacement cascade production. In general a linear function of damage energy above approximately 1 keV gives a good correlation of Frenkel pair production in copper, silver, molybdenum, and tungsten for charged particle and neutron irradiations. The damage energy constant is inversely proportional to the square root of the target mass. A logarithmic recoil energy dependence at low energies is adequate for most applications.

11275 **(ORNL/TM—7618) Metallographic study of type 304 stainless steel: long-term creep-rupture specimen.** Biss, V.A.; Sikka, V.K. (Climax Molybdenum Co. of Michigan, Ann Arbor (USA); Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-26. 14p. NTIS, PC A02/MF A01.

Microstructural analyses were performed on a type of 304 stainless steel creep-rupture specimen that exhibited a 59,900-h rupture life at 595°C and 117 MPa. The long-term creep-rupture exposure was accompanied by precipitation of $Cr_{23}C_6$ in the matrix and along the grain boundaries and iron-chromium type sigma phase along the grain boundaries. Stress-induced local grain boundary migration was evident and was associated with simultaneous dissolution of carbide particles and formation of sigma phase along the migrating boundary. In small isolated locations, austenite transoformed to ferrite.

11276 **(RFP—3040) Mechanical properties of continuously cooled uranium-2.4 weight percent niobium alloy.** Jackson, R.J. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 30 Jan 1981. Contract AC04-76DP03533. 15p. NTIS, PC A02/MF A01.

The U-2.4 wt % Nb alloy is normally quenched and isothermally aged to develop a high-strength material possessing high ductility. However, the quenching step in this operation can cause cracking when large sections are quenched. To circumvent this cracking problem, continuous cooling was studied as the means of developing the high-strength, high-ductility condition. Tension and compression bars were cooled from the single-phase gamma region (750, 800, and 900°C) at rates varying from 25 to 1600°C per hour to establish the effect of cooling rate on mechanical properties. The various cooling rates gave a large range of mechanical properties. The most effective treatment was to cool at 350°C per hour from the gamma region. The report tabulates and discusses tension, compression, and hardness properties for the heat treatments studied.

11277 **(SAND—80-7167) High temperature metallization system for solar cells and geothermal probes.** Wiley, J.D.; Perepezko, J.H.; Nordman, J.E. (Sandia Labs., Albuquerque, NM (USA)). Dec 1980. Contract AC04-76DP00789. 56p. NTIS, PC A04/MF A01.

Amorphous films of the alloys Ni-Nb, Ni-Mo, W-Si, and Mo-Si were deposited on semiconducting substrates by RF sputtering from composite cathodes. The films adhere extremely well to Si, GaAs, and GaP during and after thermal cycling from -200°C to at least 500°C. All films investigated to date have remained amorphous during 1 hour anneals at 500°C, and some alloy compositions have been found which remain amorphous after annealing at $\geqq$ 575°C. Rutherford backscatter analysis has been used to study the diffusivity of Au in amorphous Ni-Nb. $D < 10^{-18}$ cm^2/S was found at 450°C. Additional diffusion studies have been performed using Auger profiling. Initial results show that amorphous Ni-Nb and W-Si may be excellent diffusion barriers against Cu and Au, respectively, at temperatures $\leqq$ 500°C.

11278 **(UCRL—15313) Evaluation of 2 1/4 Cr-1 Mo steel for liquid lithium containment. II. Effects of post-weld heat treatment and niobium content. Annual report, 1979.** Anderson, T.L.; Edwards, G.R. (Colorado School of Mines, Golden (USA). Dept. of Metallurgial Engineering). 1979. Contract W-7405-ENG-48. 46p. NTIS, PC A03/MF A01.

The lithium corrosion resistance of the regular grade of 2 1/4 Cr-1 Mo steel can be vastly improved with a proper postweld heat treatment, but even greater improvements are needed. Results indicate that if weldments were tempered sufficiently long at 760C to remove all Mo_2C from the microstructure, even greater resistance to attack by low nitrogen lithium could be achieved. Corrosion tests should eventually be performed on regular grade 2 1/4 Cr-1 Mo steel weldments which have been given a long-term (> 25 h) post-weld temper at 760C. Lithium corrosion resistance of regular grade 2 1/4 Cr-1 Mo steel may also be improved by employing a quench and temper heat treatment. Quenched microstructures have more homogenous distribution of carbides than isothermally annealed microstructures, and if properly tempered, should provide excellent lithium corrosion resistance. Furthermore, the toughness of such a lower bainite microstructure should be better than that of the ferrite-bainitic microstructure created by an isothermal anneal. Numerous parameters, all potentially deleterious to the lithium corrosion resistance of 2 1/4 Cr-1 Mo steel, remain to be investigated; two such variables are velocity effects and lead content in the lithium.

11279 **(UCRL—50058-80-3) Advances in materials science, metals and ceramics division. Triannual progress report, June-September 1980.** Truhan, J.J.; Hopper, R.W.; Gordon, K.M. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Oct 1980. Contract W-7405-ENG-48. 37p. NTIS, PC A03/MF A01.

Information is presented concerning the magnetic fusion energy program; the laser fusion energy program; geothermal research; nuclear waste management; Office of Basic Energy Sciences (OBES) research; diffusion in silicate minerals; chemistry research resources; and chemistry and materials science research.

11280 Charged particle beam welding with beam deflection around weld pool retainers. Scheffels, W.; Steigerwald, K. (to Steigerwald Strahltechnik Gmbh (Germany)). US Patent 4,223,199. 16 Sep 1980. Filed date 25 May 1978. vp.

A method and apparatus for charged particle beam welding is provided with a beam deflection mechanism adjacent the surface of the workpiece. The beam deflection mechanism permits the use of a welding shoe for retaining a pool of molten material adjacent the point of welding.

11281 Method for homogenizing alloys susceptible to the formation of carbide stringers and alloys prepared thereby. Braski, D.N.; Leitnaker, J.M. (to Dept. of Energy). US Patent 4,221,610. 9 Sep 1980. Filed date 24 Feb 1978. vp. PAT-APPL-880,919.

A novel fabrication procedure prevents or eliminates the reprecipitation of segregated metal carbides such as stringers in Ti-modified Hastelloy N and stainless steels to provide a novel alloy having carbides uniformly dispersed throughout the matrix. The fabrication procedure is applicable to other alloys prone to the formation of carbide stringers. The process comprises first annealing the alloy at a temperature above the single phase temperature for sufficient time to completely dissolve carbides and then annealing the single phase alloy for an additional time to prevent the formation of carbide stringers upon subsequent aging or thermomechanical treatment.

11282 Glassy alloys which include iron group elements and boron. Ray, R. (to Allied Chemical Corp). US Patent 4,221,592. 9 Sep 1980. Filed date 2 Sep 1977. vp.

Iron group-boron base glassy alloys are disclosed which evidence improved ultimate tensile strengths, hardnesses and crystallization temperatures as compared with prior art glassy alloys. The alloys have the formula mam'6m"cbd where M is one iron group element (iron, cobalt or nickel), m' is at least one of the two remaining iron group elements, m" is at least one element of vanadium, manganese, molybdenum, tungsten , niobium and tantalum, "a" ranges from about 40 to 87 atom percent, "b" ranges from 0 to about 47 atom percent, "c" ranges from 0 to about 20 atom percent and "d" ranges from about 26 to 28 atom percent, with the proviso that "b" and "c" cannot both be zero simultaneously.

11283 Method of and device for plasma MIG welding. Essers, W.G. (to U S Philips Corp). US Patent 4,220,844. 2 Sep 1980. Filed date 25 Oct 1977. vp.

A plasma-MIG welding system includes establishing a plasma arc between a primary non-consumable electrode and an auxiliary nonconsumable nozzle electrode to provide a plasma flow downstream of the primary non-consumable electrode and out through such nozzle electrode. A consumable electrode is fed through the plasma flow out through the nozzle electrode, a MIG-arc being established between the consumable electrode and a workpiece. A gas stream consisting of an inert gas and an oxidizing gas is flowed past the consumable electrode in a manner to completely envelope the same and into admixture with the plasma flow without coming into contact with the non-consumable electrode. A separate gas stream provides a sheath for the resulting plasma flow after its passage through the nozzle electrode.

11284 Tensile testing at constant true plastic strain rate. Hartley, C.S. (State Univ. of New York, Stony Brook); Jenkins, D.A. *Journal of Metals ;* **32**: No. 7, 23-28(Jul 1980).

A closed-loop system for tensile testing at constant true plastic strain rate is described. The system consists of a servohydraulic testing machine for which the actuator velocity is controlled by the instantaneous minimum cross-sectional dimension of the specimen. A closed-loop temperature-control system using resistance heating of the specimen is incorporated to permit tests at elevated temperatures. Examples are given of true stress-strain curves of annealed 304 stainless steel rod and annealed Zircaloy-4 plate, tested parallel and perpendicular to the rolling direction. Problems encountered due to deformation-induced heating, noisy circuitry, and plastic anisotropy are discussed.

11285 Laser processing of materials. Narayan, J. (Oak Ridge National Lab., TN). *Journal of Metals ;* **32**: No. 6, 15-21(Jun 1980).

Laser beams provide a controlled source of heat by which surface layers of semiconductors and metals can be rapidly melted and cooled with rates exceeding 10^8°C/s. This rapid melting and solidification has been used to produce unique microstructural modifications and to obtain novel physical properties. This article summarizes the annealing of displacement damage in ion-implanted semiconductors to make superior p-n junctions and solar cells; removal of dislocation loops and precipitates to improve thermally diffused junctions; laser-induced diffusion to form p-n junctions in semiconductors deposited (instead of implanted or thermally diffused) with dopants; and fundamental studies on growth of dislocations, cell formation and alloying.

11286 In-situ observation of crack propagation by transmission electron microscopy. Ohr, S.M.; Kobayashi, S. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Journal of Metals ;* **32**: No. 5, 35-38(May 1980).

Transmission electron microscopy was used to directly observe the distribution of dislocations in the plastic zone of propagating cracks during in-situ tensile deformation of various metals including stainless steel, nickel, molybdenum, and niobium. The results show a number of new findings regarding dislocation behavior in the plastic zone and its relationship to crack propagation. The observations, generally in agreement with the fracture model proposed by Bilby et al., are the first experimental confirmation of the theory. In-situ transmission electron microscopy is expected to contribute greatly to understanding fracture phenomena.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 10139, 10364, 10378, 10378, 10686, 10686, 10847, 10980, 11107, 11108, 11108, 11109, 11109, 11109, 11110, 11110, 11110, 11119, 11120, 11279, 11312, 11458, 11832

11287 (DOE/ER/10588—1) Physics and chemistry of packing fine ceramic powders. Annual report, March 1, 1980-January 31, 1981. (Massachusetts Inst. of Tech., Cambridge (USA). Materials Processing Center). 31 Oct 1980. Contract AC02-80ER10588. 25p. NTIS, PC A02/MF A01.

The current research program is centered on the special, unique features of a monodispersed powder: the stability of the suspension, the ordered packing characteristics, the sintering behavior and the simplification in developing analytical models to describe the system. Three model particulate systems, TiO_2, SiO_2, Si_3N_4, were chosen because of their different characteristics. Titanium dioxide and SiO_2 dispersions can be studied in aqueous solutions, while Si_3N_4 must be studied in nonaqueous liquids because of the reaction which forms SiO_2 surface layers. Steric stabilization using macromolecules in the nonionic solutions will be examined. The oxides have the advantage that more is known about dispersion and adsorption characteristics. Silicon nitride has enormous technological value as a high temperature structural material, so these studies could have important direct applications.

11288 (DOE/ET/37213—T1) High temperature thermal conductivity measurements of UO_2 by Direct Electrical Heating. Final report. Bassett, B. (Arizona Univ., Tucson (USA). Dept. of Nuclear Engineering). Oct 1980. Contract AS02-78ET37213. 148p. NTIS, PC A07/MF A01.

Thesis.

High temperature properties of reactor type UO_2 pellets were measured using a Direct Electrical Heating (DEH) Facility. Modifications to the experimental apparatus have been made so that successful and reproducible DEH runs may be carried out while protecting the pellets from oxidation at high temperature. X-ray diffraction measurements on the UO_2 pellets have been made before and after runs to assure that sample oxidation has not occurred. A computer code has been developed that will model the experiment using equations that describe physical properties of the material. This code allows these equations to be checked by comparing the model results to collected data. The thermal conductivity equation for UO_2 proposed by Weilbacher has been used for this analysis. By adjusting the empirical parameters in Weilbacher's equation, experimental data can be matched by the code. From the several runs analyzed, the resulting thermal conductivity equation is $\lambda = 1/4.79 + 0.0247T/ + 1.06 \times 10^{-3} \exp[-1.62/kT/] - 4410. \exp[-3.71/kT/]$

where λ is in w/cm K, k is the Boltzman constant, and T is the temperature in Kelvin.

11289 (FE—2215-13(Vol.3), pp 20) **Phase equilibria in Fe-Al-O system.** Meyers, C.E.; Mason, T.O.; Petuskey, W.T.; Halloran, J.W.; Bowen, H.K. (Massachusetts Inst. of Tech., Cambridge). Apr 1979.

In Critical contributions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.

The composition limits for the spinel solid solution Fe(Fe/sub 1-x/Al/sub x/)$_2$O$_4$ have been determined experimentally as a function of oxygen pressure at 1280, 1380 and 1500°C. The method of precise lattice measurement was used. The results have been combined with information from the literature to develop self-consistent stability diagrams of P$_O$/sub 2/ versus cation fraction at constant temperature for the iron-aluminum oxide system.

11290 (FE—2215-13(Vol.3), pp 23) **Cation and defect chemistry of iron-aluminate spinels.** Mason, T.O.; Bowen, H.K. (Massachusetts Inst. of Tech., Cambridge). Apr 1979.

In Critical contributions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.

A model describing cation distribution and defect concentrations in iron aluminate spinels is presented. Cation distribution equilibrium constants are derived from phase boundary data at 1500°C and 1280°C. Estimations of the defect concentrations for the entire solid solution are possible using defect equilibrium constants for Fe_3O_4.

11291 (FE—2215-13(Vol.3), pp 38) **Iron diffusion in iron aluminate spinels.** Halloran, J.W.; Bowen, H.K. (Massachusetts Inst. of Tech., Cambridge). Apr 1979.

In Critical contributions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.

The diffusion coefficient of iron 59 in iron aluminate spinels (Fe_3O_4-$FeAl_2O_4$) was measured by means of serial sectioning. The results were analyzed with a defect model assuming that the predominant defects were cation vacancies and interstitials. At 1380$_0$C diffusion occurs in Fe_3O_4 and $Fe(Fe_{1.51}Al_{0.49})O_4$ by an interstitial mechanism at low P/sub O2/, and a vacancy mechanism at high P/sub O2/. Diffusion of iron is by the vacancy mechanism for higher hercynite concentrations except that the results for end member, $FeAl_2O_4$ suggest interstitial mechanism. At 10^{-6} atm O_2, an Arrhenius plot of D/sub Fe/ exhibits a minimum for Fe_3O_4 and $Fe(Fe_{1.51}Al_{0.49})O_4$. This effect is explained in terms of a mechanism change. D/sub Fe/ is essentially independent of temperature in $Fe(Fe_{1.03}Al_{0.97})O_4$ and $Fe(Fe_{0.54}Al_{1.46})O_4$. The value of activation energy for diffusion depends not only on composition but also whether the oxygen pressure or CO_2/CO ratio is fixed. These materials are of interest as candidate materials for high-temperature electrodes for coal-fired MHD generators.

11292 (LBL—11830) **Cavitational effects during creep in polycrystalline alumina.** Blumenthal, W.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1980. Contract W-7405-ENG-48. 56p. NTIS, PC A04/MF A01.

Thesis.

Cavitation in deformed fine-grained Al_2O_3 was studied as a function of deformation temperature and strain rate. Three distinct cavity profiles were observed in varying proportions depending on the temperature and loading rate. Symmetrically shaped equilibrium cavities were observed at low stress and temperature. Crack-like (nonequilibrium) cavities were observed at higher stress and temperature. Full-facet cavities were observed as the end product of crack-like cavity growth and as a precursor to coalescence. These observations provide strong support for the cavity growth model developed by Chuang, et al. and establish cavitation as an important deformation and failure mechanism in ceramic materials.

11293 (ORO—5866-11) **Progress report on radiation effects on solids.** Crawford, J.H. Jr. (North Carolina Univ., Chapel Hill (USA). Dept. of Physics and Astronomy). 1980. Contract AS05-78ER05866. 10p. NTIS, PC A02/MF A01.

Research topics reported are: radiation effects and defects in spinel ($MgAl_2O_4$), F and F^+ centers in Al_2O_3, and irradiation experiments on MgO:Li crystals. (DLC)

11294 **Polycrystalline superhard material and method of producing thereof.** Bakul, V.N.; Deryagin, B.V.; Fedoseev, D.V.; Gerasimenko, V.K.; Nikitin, J.I.; Poltoratsky, V.G.; Prikhna, A.I.; Varnin, V.P.; Vnukov, S.P. (to Institut Sverkhtverdykh Materialov Akademii Nauk Ukrainskoi Ssr (Union Of Soviet Socialist Republics)). US Patent 4,220,677. 2 Sep 1980. Filed date 25 Jan 1979. vp.

The proposed polycrystalline superhard material comprises sintered particles of cubic boron nitride coated over the whole surface thereof with a layer of a crystalline compound of the chemical formula BsNyCz, where x, y and z can assume any value from 0 to 1, said compound binding together the particles of the cubic boron nitride. According to the present invention the proposed material is produced in the following way: particles of cubic boron nitride are placed in a flow of a gas containing carbon for a carbon layer 1-100 a thick to be built up on the whole surface of said particles. Then the particles of cubic boron nitride with the carbon layer built up over the whole surface of the particles are subjected to sintering at a temperature and under a pressure corresponding to the region of thermodynamic stability of cubic boron nitride. The herein-proposed material is highly uniform and features mechanical properties superior to those of the known cubic boron nitride materials. Thus, for example, under the identical conditions of cutting, durability of cutters made from the proposed material is 2-5 times higher than that of the cutters made from the known material based on cubic boron nitride.

3603 Composite Materials

11295 (SAND—80-2514) **Fiber content in molded DC-302 composites.** Trujillo, R.E. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 32p. NTIS, PC A03/MF A01.

A method of analyzing molded silicone parts for fiber content, particulate content, and silicone resin content has been developed. The method involves dissolving the silicone resin component of the cured DC-302 part in pyrrolidine and separating this solubilized resin from the pyrrolidine insoluble glass fiber and particulate components by filtration. The glass fiber is separated from the particulate matter through micro-sieves. The fibers are retained on the sieves during this washing procedure. This method permits the determination of percent resin, percent fiber, and percent particulate in molded DC-302 parts. Data from molded DC-302 parts, analyzed by this technique, suggest that fiber content distribution can be a major factor in defining part strength and crack propensity.

3604 Polymers And Plastics

REFER ALSO TO CITATION(S) 10602, 10602, 10609

3606 Other Materials

REFER ALSO TO CITATION(S) 10490, 10491, 10493, 10494, 10498, 10499, 10500, 10512, 10517, 10517, 10518, 10521, 10522, 10530, 10531, 10532, 1053², 10539, 10540, 10543, 10544, 11267, 11285, 11328, 11443

11296 (AD-A—086991) **Growth and application of cadmium telluride. Final technical report Feb 77-Jan 80.** Williams, R.H.; Patterson, M.H. (New Univ. of Ulster, Coleraine (UK). School of Physical Sciences). Jan 1980. 171p. NTIS, PC A08/MF A01.

Large Single Crystals of CdTe were grown by the methods of Liquid Encapsulated Czochralski, Fast Vertical Bridgman, Travelling Heater Method, Stockbarger method. Electrical characterization was done by Seebeck, Hall Effect and Conductivity measurements. Surfaces were investigated using XPS, UPS, AES and LEED. Metal-CdTe contacts were fabricated. Formation of these was monitored using XPS, UPS, LEED, AES. Barrier Heights were established by I-V, C-V and UPS measurements. Results show that the effect of the CdTe surface on the type of contact formed is very marked.

11297 **(DOE/ER/10598—1) Development and characterization of high temperature electrically conducting oxides. Progress report, April 1, 1980-February 28, 1981.** Anderson, H.U.; Sorrell, C.A. (Missouri Univ., Rolla (USA)). Nov 1980. Contract AC02-80ER10598. 7p. NTIS, PC A02/MF A01.

The goals of the proposed study are to study the interrelationships between electrical conductivity, oxidation-reduction kinetics, defect structure, and composition for n-type and p-type binary and ternary transition metal oxides. Experimental aspects include specimen preparation, thermogravimetric measurements, x-ray diffraction, transmission electron microscopy, electrical conductivity, and Seebeck measurements. The initial stages of this program have been devoted to equipment fabrication and sample preparation. The data collection portion of the work is just now being started.

11298 **Neutron scattering and lattice dynamics of materials with layered structures.** Wakabayaski, N.; Nicklow, R.M. (Oak Ridge National Lab., TN (USA)). pp 409-464 of Electrons and phonons in layered crystal structures. Wieting, T.J. (Naval Research Lab., Washington, DC (USA)); Schlueter, M. (Bell Labs., Murray Hill, NJ (USA)) (eds.). Dordrecht, Netherlands; D. Reidel (1979).

A brief summary of fundamental equations for the Born-von Karman formalism is presented. A force model is then constructed in which certain parameters are used to characterize the interatomic interactions. The inelastic scattering of neutrons has proved to be an invaluable experimental technique for studying in detail the dynamics of crystalline solids, and a brief summary of the main results which are used in the interpretation of experimental data is presented. Atomic vibrations in layered compounds are fully discussed and neutron scattering experiments on layered compounds outlined. Experimental data, with some emphasis on experimental details, are presented for graphite, transition metal dichalcogenides, GaSe, PbI_2 and iodine.

11299 **(IS-M—308) Photoacoustic imaging of compositional variations in Hg/sub 1-x/Cd/sub x/Te semiconductors.** McClelland, J.F.; Kniseley, R.N.; Schmit, J.L. (Ames Lab., IA (USA); Honeywell Technology Center, Bloomington, MN (USA)). 1979. Contract W-7405-ENG-82. 12p. (CONF-8009130—1). NTIS, PC A02/MF A01.

From International symposium on scanned image microscopy at the Royal Society; London, UK (22 Sep 1980).

Scanned image microscopy utilizing photoacoustic (PA) detection under certain experimental conditions can image spatial variations in various material properties that have a role in PA signal generation. The properties involved are related to the four primary processes that occur in the PA signal generation sequence. These include (1) reflection and (2) absorption of incident light by the sample followed by (3) deexcitation and (4) transport of the absorbed energy. In the measurements performed, a fraction of the absorbed energy that evolves as heat is transferred into a gas adjacent to the sample. The acoustic signal is generated in the gas by thermal expansion and sensed by a transducer. The preliminary work reported demonstrates the possibility of imaging compositional variations in the alloy semiconductor Hg/sub 1-x/Cd/sub x/Te.

40 CHEMISTRY

4001 Analytical And Separations Chemistry

11300 **(BNL—28668) Application of PIXE, RBS and high energy proton microbeams to the elemental analysis of coal and coal waste.** Kraner, H.W.; Hanson, A.L.; Jones, K.W.; Oakley, S.A.; Duedall, I.W.; Woodhead, P.M.J. (Brookhaven National Lab., Upton, NY (USA); State Univ. of New York, Stony Brook (USA). Marine Sciences Research Center). 1980. Contract AC02-76CH00016. 17p. (CONF-801227—3). NTIS, PC A02/MF A01.

From Atomic and nuclear methods in fossil energy research meeting; Mayaguez, Puerto Rico (1 Dec 1980).

Proton and x-ray induced x-ray emission have proved to be sensitive and convenient methods to measure major trace element concentrations in bulk quantities of coal and coal waste materials. These techniques are complementary in their sensitivities as a function of atomic number, and both require little sample preparation. The PIXE measurements were made with the proton beam in air in a microprobe configuration. Collimated proton beam scans were made on several thin sections of fly ash/sludge block materials and good trace sensitivities were observed for small specific volumes; SEM scans showed a high degree of material homogeneity which precluded significant elemental variations at the $\sim$ 100 μm spatial resolution used. Rutherford backscattering was used to directly observe major and minor elemental concentrations in coal waste materials and in several representative ranks of coals. RBS is useful for only trace concentrations of heavy elements, but it does provide a method independent of fluoresced x rays for detection of possible middle Z interferences. Arsenic, present in trace amounts in coal, is an element of concern and is enriched in fly ash. The form of As in fly ash is unknown. However, because of its volatility most of the As probably becomes attached to the surfaces of the fly ash particles during and subsequent to combustion processes. This view is supported by the fact that As is rapidly mobilized in aqueous solutions whose pH > 9.

11301 **(K—2019) Determination of cadmium, chromium, nickel, and lead in urine using Graphite Furnace Atomic Absorption spectrophotometry.** Hamilton, L.G.; Farrar, R.B. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Dec 1980. Contract W-7405-ENG-26. 32p. NTIS, PC A03/MF A01.

Procedures using graphite furnace atomic absorption spectrophotometry for the determination of cadmium, chromium, nickel, and lead are described in this report. The lowest concentrations reported using the procedure are 5 μg/l for cadmium, chromium, and nickel and 10 μg/l for lead.

11302 **(K—2021) Gamma spectrometric determination of uranium-235 in uranium hexafluoride in 1S and 2S cylinders.** Clark, E.E. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jan 1981. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01.

The abundance of uranium-235 in uranium hexafluoride contained in 1S and 2S sample cylinders is measured by using the characteristic 186-keV gamma rays of uranium-235 that pass through the cylinder walls. The gamma-count rate, corrected for cylinder-wall attenuation, is translated into uranium-235 isotopic abundance via an empirical calibration. The relative standard deviation, per 1000-sec count, is about 1% at 3 wt % uranium-235.

11303 **(MLM—2799) GRPAUT: a program for Pu isotopic analysis (a user's guide). ISPO task A.76.** Fleissner, J.G. (Mound Facility, Miamisburg, OH (USA)). 30 Jan 1981. Contract AC04-76DP00053. 165p. (ISPO—128). NTIS, PC A08/MF A01.

GRPAUT is a modular program for performing automated Pu isotopic analysis supplied to the International Atomic Energy Agency (IAEA) per ISPO Task A.76. Section I of this user's guide for GRPAUT presents an overview of the various programs and disk files that are used in performing a Pu isotopic analysis. Section II describes the program GRFEDT which is used in creating and editing the analysis parameter file that contains all the spectroscopic information needed at runtime by GRPAUT. An example of the dialog and output of GRFEDT is shown in Appendix B. Section III describes the operation of the various GRPAUT modules: GRPNL2, the peak stripping module; EFFCH2, the efficiency calculation module; and ISOAUT, the isotopic calculation module. (A description of the peak fitting methodology employed by GRPNL2 is presented in Appendix A.) Finally, Section IV outlines the procedure for determining the peak shape constants for a detector system and describes the operation of the program used to create and edit the peak shape parameter files. An output of GRPAUT, showing an example of a complete isotopic analysis, is presented in Appendix C. Source listings of all the Fortran programs supplied to the Agency under ISPO Task A.76 are contained in Appendix E.

11304 **(SAND—79-0653) Spectrophotometric determination of cobalt(II) in the presence of the cobalt(III) coordination compound 2-(5-cyanotetrazolato)pentaamminecobalt(III) perchlorate.** Merrill, R.M. (Sandia Labs., Albuquerque, NM (USA)). Dec 1980. Contract AC04-76DP00789. 16p. NTIS, PC A02/MF A01.

A colorimetric procedure for the determination of trace quantities of cobalt(II) in the presence of the explosive cobalt(III) coordination compound 2-(5-cyanotetrazolato)pentaamminecobalt(III) perchlorate is described. Determinations were made at 693 nm in a solvent system consisting of 40 volume percent dimethyl sulfoxide and 7.2 molar hydrochloric acid. The system obeys Beer's law up to 60 μgm Co(II)/mL of solution with a molar extinction coefficient of 626 1 $mole^{-1}cm^{-1}$. The Sandell sensitivity is 0.091 μgm $Co(II)/cm^2$ for 0.001 absorbance. Molar extinction coefficients, at a fixed 7.2 molar hydrochloric acid content, were determined as a function of dimethyl sulfoxide concentration. The extinction coefficients at 40 volume % dimethyl sulfoxide are comparable to previously published cobalt(II) molar extinction coefficients obtained in 15 molal HCl. The procedure was used to help determine the extent of thermal decomposition of the cobalt(III) compound.

11305 **Vibrating probe density meter for determination of atom percent deuterium in lithium hydride-lithium deuteride mixtures.** Green, L.A.; Adams, T.T.; Hamilton, J.H. (Oak Ridge Y-12 Plant, TN). Contract W-7405-ENG-26. *Analytical Chemistry ;* **53**: No. 2, 243-245(Feb 1981).

Atom percent deuterium in lithium hydride-lithium deuteride (LiH/LiD) mixtures are determined from the density of a water-heavy water mixture obtained by the decomposition and oxidation of samples. The density is measured by using a vibrating tube density meter which requires to LiH/LiD standards, only pure water and air or other density standards. The samples are decomposed in a Leco induction furnace, converted to the correponding oxides, and condensed in a specially designed cold trap fabricated for efficient entrapment without contact with atmospheric water vapor. A vibrating probe density meter determines the density of the water-heavy water mixture; the density is proportional to the atom percent deuterium in the LiH/LiD sample. At the 95% confidence level, the atom percent dueterium is determined with a precision of less than 0.2% (relative standard deviation) for a single determination. By use of two Leco induction furnaces and one vibrational probe density meter, 18 samples per 8-h shift can be analyzed.

11306 **Analysis of a workplace air particulate sample by synchronous luminescence and room-temperature phosphorescence.** Vo-Dinh, T.; Gammage, R.B.; Martinez, P.R. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Analytical Chemistry ;* **53**: No. 2, 253-258(Feb 1981).

An analysis of a XAD-2 resin extract of a particulate air sample collected at an industrial environment was conducted by use of two simple spectroscopic methods performed at ambient temperature, the synchronous luminescence and room-temperature phosphorescence techniques. Results of the analysis of 13 polynuclear aromatic compounds including anthracene, benzo[a]pyrene, benzo[e]pyrene, 2,3-benzofluorene, chrysene, 1,2,5,6-dibenzanthracene, dibenzthiophene, fluoranthene, fluorene, phenanthrene, perylene, pyrene, and tetracene were reported.

11307 **Differential determination of chromium(VI)-chromium(III) with poly(dithiocarbamate) chelating resin and inductively coupled plasma-atomic emission spectrometry.** Miyazaki, A.; Barnes, R.M. (Univ. of Massachusetts, Amherst). Contract DE-AC02-77EV-04320. *Analytical Chemistry ;* **53**: No. 2, 364-366(Feb 1981).

This investigation has demonstrated that the poly(dithiocarbamate) resin is usable for the differential determination of Cr(VI)-Cr(III) mixtures. In this example, a concentration factor of 12.5 was obtained. However, on the basis of previous experience with the poly(dithiocarbamate) resin both large sample volumes and smaller final solution volumes can be employed in order to increase the concentration factor. The present technique is suitable for chromium determination by inductively coupled plasma-atomic emission spectrometry (ICP-AES), atomic absorption spectrometry (AAS), and other spectrochemical methods. However, the low limit of detection for chromium achieved by electrothermal atomization AAS combined with a suitable small final digested resin solution volume may allow extension of the differential analysis to low initial Cr(VI) and Cr(III) concentration-levels. Although high chloride concentration does not interfere with the Cr(VI) determination in this technique, in the total chromium procedure a chloride concentration of greater than 250 mg of Cl/L prevents complete recovery of chromium possibly through the loss of chromyl chloride. In this situation, removal of chloride by precipitation with silver nitrate may be required. This limitation is not unique to the resin approach and is common in methods requiring oxidation of Cr(III) to Cr(IV). The present technique is not affected by large concentrations of alkali and alkaline earth elements or manganese because these elements do not complex with the resin. In addition, the technique is simple and provides acceptable precision.

11308 **Simulation of interfacial two-step consecutive reactions by diffusion in the mass-transfer kinetics of liquid-liquid extraction of metal cations.** Danesi, P.R. (Argonne National Lab., IL); Vandergrift, G.F.; Horwitz, E.P.; Chiarizia, R. *Journal of Physical Chemistry, The ;* **84**: No. 26, 3582-3587(25 Dec 1980).

Interfacial two-step consecutive reactions (ITSCR) have recently been proposed by us as the rate-controlling steps of many liquid-liquid mass-transfer processes involving strong surface-active extractants. In some instances, however, diffusion can contribute to the measured rate because of a lack of turbulence in one or both of the two phases. A mathematical model has therefore been developed to evaluate the possibility that interfacial film diffusion coupled to a simple one-step reaction (occurring on the aqueous side of the interface) can mimic ITSCR. Analysis of the model indicates that this possibility does indeed exist, especially when fast extraction reactions take place. The developed model has been used to interpret experimental kinetics data obtained at low stirring, such as the extraction of pertechnetate and plutonium nitrate by long-chain quaternary and tertiary alkylammonion salts. Analysis of the data provides reasonable values for the thickness of the diffusion films. The rate constants evaluated in this way seem, however, too low to be representative of bulk aqueous-phase reactions. It is therefore postulated that the chemical reaction which accompanies the mass transfer occurs in a region so close to the interface that it is characterized by physicochemical properties different from those of bulk water. Consequently, rate constants quite different from those expected for a bulk aqueous-phase reaction are found.

11309 **Method of analysis of asbestiform minerals by thermoluminescence.** Bradley, E. W.; Fisher, G. L. (to Dept. of Energy). US Patent 4,220,856. 2 Sep 1980. Filed date 3 Nov 1978. vp.

PAT-APP-957,617.

A method for the qualitative and quantitative analysis of asbestiform minerals, including the steps of subjecting a sample to be analyzed to the thermoluminescent analysis, annealing the sample, subjecting the sample to ionizing radiation, and subjecting the sample to a second thermoluminescent analysis. Glow curves are derived from the two thermoluminescent analyses and their shapes then compared to established glow curves of known asbestiform minerals to identify the type of asbestiform in the sample. Also, during at least one of the analyses, the thermoluminescent response for each sample is integrated during a linear heating period of the analysis in order to derive the total thermoluminescence per milligram of sample. This total is a measure of the quantity of asbestiform in the sample and may also be used to identify the source of the sample.

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REFER ALSO TO CITATION(S) 10109, 10350, 11030, 11349, 11706, 11707, 11708, 11812

11310 **(AD-A—087062) Experimental determination of initial vibrational and rotational energy distributions from the reaction D + F2. Final report 1 Feb 79-31 Jan 80.** Jonathan, N. (Southampton Univ. (UK)). 21 Feb 1980. 13p. NTIS, PC A02/MF A01.

Preparatory experiments and construction of apparatus leading up to attempts to obtain the initial vibrational and rotational energy distribution of deuterium fluoride produced in the gas phase reaction D + F2 yields DF + F are described. Discrepancies between results obtained with the present apparatus and that of other workers are discussed and resolved.

11311 **(DOE/ER/01797—96) Research in actinide chemistry. Progress report, March 1, 1980-February 28, 1981.** Choppin, G.R. (Florida State Univ., Tallahassee (USA). Dept. of Chemistry). 1981. Contract AS05-76ER01797. 18p. NTIS, PC A02/MF A01.

Visible spectroscopy, NMR ($^{1}H_{1}$, $^{6}C_{13}$, $^{57}La_{139}$) spectroscopy, potentiometry, and calorimetry were used in lanthanide studies which have allowed much more thorough interpretation of actinide tracer studies. In the last several years, the studies were expanded to include actinides in the IV, V and VI oxidation states. Part of the research during this time was directed to investigation of actinide interaction with naturally occurring polyelectrolytes such as humic and fulvic acids. Since redox reactions seemingly occur in some of these interactions, a study of plutonium and neptunium redox behavior in the presence of organic complexing agents was started. Preliminary data are given for reduction of Np(VI) by various organic acids.

11312 **(DOE/ER/03029—T1) Supported catalysts: synthesis and characterization. Final report.** Turkevich, J. (Princeton Univ., NJ (USA). Dept. of Chemistry). 1980. Contract AS02-76ER03029. 5p. NTIS, PC A02/MF A01.

The basic steps in the synthesis of supported catalysts are: nucleation, growth and coagulation. The nucleation process is one of polymerization-condensation of the starting inorganic monomer. Silicic acid or hydrated aluminum ions polymerize individually to form long polymeric chains. In the case of metal systems the metal ion and the organic reducing agent form co-polymers which, on reaching a certain size, undergo internal redox reaction to produce the colloidal metal. Using different metal ions, colloidal alloys can be formed. These polymers have been isolated in the case of gold and now are being studied for platinum, palladium and their alloys. Their formation was investigated by the STEM electron microscope at Brookhaven. The growth step is carried out by innoculating a solution containing a potential reducing agent (such as gold chloride or palladium chloride and hydroxyl amine) with nuclei of either platinum, gold, or palladium. In this way by control of the proportion of the nuclei to the ion, the gold and palladium can be grown to the desired size and gold layered on platinum or palladium. Platinum can be grown on platinum by innoculating a hydrogen-platinum chloride system with platinum nuclei. The stability of these colloidal sols is controlled by the electric charge on the particles which counteracts the effect of van der Waals' attraction. The charge is determined by adsorbed ions and can be controlled both in magnitude and in sign. The ionic atmosphere around each particle is controlled by the ionic strength of the solution. The characterization of the materials so prepared can be made both in solution and in the solid phase. The techniques employed are optical absorption, light-scattering, viscosity, ultra-centrifugation, conventional electron microscopy, ultrahigh resolution electron microscopy, laser Raman spectroscopy, electron spin resonance and carbon-13 NMR of absorbed molecules.

11313 **(DOE/ER/04991—2) ESR studies of surface adsorption and catalysis under ultra-high vacuum conditions. Progress report, March 1, 1980-February 29, 1981.** Freed, J.H. (Cornell Univ., Ithaca, NY (USA). Dept. of Chemistry). Nov 1980. Contract AS02-78ER04991. 53p. NTIS, PC A04/MF A01.

This project is directed to developing ESR for the study of surface adsorption and catalysis on clean well-characterized metallic and oxide surfaces under ultra-high vacuum (UHV) conditions and to compare the results with real surfaces, which are important in actual catalysis. Results with ESR-UHV system on the NO_2/Cu system showed that only in the presence of H_2O can the surface process(es) proceed that lead to stable Cu^{2+} complexes which are observable by ESR. By monitoring the CREMSEE (cyclotron-resonance from microwave-induced secondary electron emissions) threshold, definite evidence for the oxidation of the Cu surface by the clean NO_2 has been obtained. In real systems, as opposed to the clean surfaces prepared under UHV conditions, small amounts of H_2O are usually present. The UHV studies permitted a demonstration of the reactivity requirements. Detailed studies of the oxidation process of NO_2 on Cu have been performed. A newer ESR-UHV system with better expected performance has been built. An extensive study of motional dynamics of free radicals on supported surfaces has been completed. These include the O_3^- radical absorbed on Ti supported on crushed vycor and NO_2 adsorbed on crushed vycor. The O_2^- is found to exhibit planar rotation about an axis perpendicular to the internuclear axis of the O_2^- and parallel to the normal to the plane. The higher temperature motion may be fit with a small activation energy of 0.5Kcal/mole, while the lower temperature motion shows anomalies. The NO_2 exhibits planar-rotation at the lower temperature, but above 77°K it becomes more nearly isotropic presumably due to translational diffusion. Preliminary experiments imply that addition of acetylene increases the rate of rotational motion of the O_2^-. Preliminary studies leading to time-resolved UHV-ESR experiments of photo-induced catalysis have been performed with the new excimer laser.

11314 **(LBL—11690) Surface science and heterogeneous catalysis.** Somorjai, G.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1980. Contract W-7405-ENG-48. 37p. (CONF-8005136—1). NTIS, PC A03/MF A01.

From Conference of the Chemical Society of Switzerland; Zurich, Switzerland (14 May 1980).

The catalytic reactions studied include hydrocarbon conversion over platinum, the transition metal-catalyzed hydrogenation of carbon monoxide, and the photocatalyzed dissociation of water over oxide surfaces. The method of combined surface science and catalytic studies is similar to those used in synthetic organic chemistry. The single-crystal models for the working catalyst are compared with real catalysts by comparing the rates of cyclopropane ring opening on platinum and the hydrogenation of carbon monoxide on rhodium single crystal surface with those on practical commercial catalyst systems. Excellent agreement was obtained for these reactions. This document reviews what was learned about heterogeneous catalysis from these surface science approaches over the past 15 years and present models of the active catalyst surface.

11315 **(LBL—11800) Reactions of sulfite and nitrite ions in aqueous solutions.** Chang, S.G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1980. Contract W-7405-ENG-48. 29p. (CONF-801173—1). NTIS, PC A03/MF A01.

From DOE advanced environmental control technology program conference; Morgantown, WV, USA (6 Nov 1980).

This paper reviews the kinetic studies of reactions that can take place as a result of interactions between sulfite/bisulfite ions S(IV) and nitrite ions (III) and presents the result of model calculations that give the concentration profile of species produced in this system as a function of reaction time. The effect of temperature, pH, and concentrations of reactant are shown.

11316 **(UCID—18795) Mathematical solution to the kinetic rate expression for aluminum trihydroxide crystallization in caustic aluminate.** Nitta, C.K.; Homsy, R.V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Dec 1980. Contract W-7405-ENG-48. 20p. NTIS, PC A02/MF A01.

Laboratory experiments investigating the rate of crystallization of aluminum trihydroxide over a range of sodium hydroxide concentration and temperature have yielded a differential equation describing the kinetics. This equation is integrated analytically to give a closed-form solution for sodium aluminate concentration as a function of time. Predicted results agree well with experimental data.

11317 **(UCRL—85232) Electrolytes: transport properties and non-equilibrium thermodynamics.** Miller, D.G. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Dec 1980. Contract W-7405-ENG-48. 27p. (CONF-810210—1). NTIS, PC A03/MF A01.

From 2. Australian thermodynamics conference; Melbourne, Australia (15 Feb 1981).

This paper presents a review on the application of non-equilibrium thermodynamics to transport in electrolyte solutions, and some recent experimental work and results for mutual diffusion in electrolyte solutions.

11318 **Complexation of some transition metls, rare earth elements, and thorium with a poly(dithiocarbamate) chelating resin.** Miyazaki, A.; Barnes, R.M. (Univ. of Massachusetts, Amherst). Contract DE-AC02-77EV-04320. *Analytical Chemistry ;* **53**: No. 2, 299-304(Feb 1981).

Complexation properties of a poly(dithiocarbamate) resin for Fe(III), Fe(II), Cr(VI), Cr(III), V(V), V(IV), T(IV), Mo(VI), W(VI), Th(IV), 14 rare earth elements, and Os are examined by inductively coupled plasma-atomic emission spectrometry (ICP-AES). Fe(III) and Cr(VI) complex with the resin, whereas Fe(II) and Cr(III) do not. Considerable differences in uptake also exist between V(V) and V(IV) and Ce(III) and Ce(IV). The digestion of the resin with nitric acid followed by dilution with (3 + 1) nitric acid-water is suitable for inductively coupled plasma-atomic emission spectrometry except for W.

11319 **Kinetics and mechanism for the catalytic oxidation of sulfur dioxide on carbon in aqueous suspensions.** Brodzinsky, R.; Chang, S.G.; Markowitz, S.S.; Novakov, T. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Journal of Physical Chemistry, The ;* **84**: No. 25, 3354-3358(11 Dec 1980).

Combustion-produced soot (carbonaceous) particles have been found to be efficient catalysts for SO_2 oxidation, especially in the presence of liquid water. A kinetic study of the catalytic oxidation of SO_2 on carbon particles suspended in solution has been carried out. The reaction was found to be first order with respect to the concentration of carbon particles, 0.69th order with respect to dissolved oxygen, between zero and second order with respect to S(IV) concentrations, and independent of the pH. Temperature studies were carried out, and an activation energy for this reaction was determined. A four-step mechanism is proposed for this carbon-catalyzed oxidation reaction.

11320 **Photoxidation of sulfur dioxide in low-temperature matrices.** Sodeau, J.R.; Lee, E.K.C. (Univ. of California, Irvine). Contract AT-03-76-ER-20217. *Journal of Physical Chemistry, The ;* **84**: No. 25, 3358-3362(11 Dec 1980).

The mechanism of photoxidation of sulfur dioxide has been investigated at low temperatures. Monomeric sulfur dioxide was found to be photochemically inactive, and no evidence was found for the existence of $[SO_4]^*$ in an oxygen matrix. In contrast, the dimeric species, $(SO_2)_2$, was found to be readily photoxidized to sulfur trioxide in an oxygen matrix at 12 K.

11321 **Kinetics and mechanism of the complex formation reactions between Cu(II) and Fe(III) aqueous species and a β-hydroxy oxime in toluene.** Danesi, P.R. (Argonne National Lab., IL); Chiarizia, R.; Vandegrift, G.F. *Journal of Physical Chemistry, The ;* **84**: No. 25, 3455-3461(11 Dec 1980).

The kinetics of the complex formation reaction between Cu(II) and Fe(III) aqueous species, present in a 2 MCl^- medium, and a β-hydroxy oxime (2-hydroxy-5-tert-octylacetophenone oxime) dissolved in toluene has been studied by using a highly stirred apparatus which allows the contribution of interfacial film diffusion processes to the measured rate to be assumed equal to zero. The results obtained have indicated that the reactions take place at the interface. Rate laws have been measured. These rate laws have been explained by assuming as rate-determining steps certain interfacial reactions. The low values of the complex formation rate constants have been explained as being derived from the particular nature of the molecular environment where the reactions take place. A qualitative description of the physicochemical properties of the aqueous-organic interface and their influence on the rate of the interfacial chemical reactions has been also proposed in terms of interfacial structuring effects and interfacial steric effects. A reaction scheme where A (associative), I/sub d/ (dissociative interchange), and SCS (sterically controlled substitution) mechanisms are simultaneously operative has been suggested.

11322 **Low-temperature heat capacity of some alkali metal tungstates.** Pan, P.H.; Shanks, H.R.; Bevolo, A.J.; Danielson, G.C. (Ames Lab., IA). *Journal of Solid State Chemistry ;* **35**: No. 2, 176-180(15 Nov 1980).

Heat capacity measurements have been made on the two triclinic tungstates, $Li_{0.2}WO_3$ and $Na_{0.33}WO_3$ from 1 to 60°K. In addition to the normal Debye term the data show a large contribution which can be fit to a single Einstein mode associated with the oscillation of the alkali ions in the holes formed by the corner bonding of six WO_6 octahedra. The Einstein characteristic temperatures obtained are 71 +- 2 and 78 +- 2°K for $Li_{0.2}WO_3$ and $Na_{0.33}WO_3$, respectively. The results are compared with those reported earlier for the hexagonal tungsten bronzes.

11323 **Ordering in Pb(Mg/sub 1/3/Nb/sub 2/3/)O_3-Pb(Mg/sub 1/2/W/sub 1/2/)O_3 solid solutions.** Amin, A. (Pennsylvania State Univ., University Park); Newnham, R.E.; Cross, L.E.; Nomura, S.; Cox, D.E. *Journal of Solid State Chemistry ;* **35**: No. 2, 267-271(15 Nov 1980).

Compositional ordering was found to occur in the ferroelectric (1 - x)Pb(Mg/sub 1/3/Nb/sub 2/3/)O_3-antiferroelectric x Pb(Mg/sub 1/2/W/sub 1/2/)O_3 solid solution system. X-ray diffraction and neutron profile fitting structure refinement were used to refine one such composition with $x = 0.9$. The paraelectric structure of compositions with $x < 0.2$ is that of the disordered perovskite (space group Pm3m), whereas for $0.2 \leq x < 1.0$ the structure is that of ordered perovskite (space group Fm3m). The oxygen octahedra in the ordered state are regular but no longer equivalent.

11324 **Metal clusters with exposed and low-coordinate nitride nitrogen atoms.** Tachikawa, M. (Univ. of California, Berkeley); Stein, J.; Muetterties, E.L.; Teller, R.G.; Beno, M.A.; Gebert, E.; Williams, J.M. *Journal of The American Chemical Society ;* **102**: No. 21, 6648-6649(8 Oct 1980).

The synthesis and structural characterization of a prototypic series of iron nitride clusters in which the nitrogen atoms are exposed and of low coordination number, namely four and five are described. The term nitride denotes species in which a nitrogen atom is only within bonding distance of metal atoms. The clusters prepared were $[Fe_4N(CO)_{12}^-]$, $[Fe_3N(CO)_{14}^-]$. The 62-electron four-iron nitrides should have butterfly structures and the 74-electron five-iron nitrides should have square-pyramidal structures. 1 figure.

11325 **Infrared intensity measurements of cryodeposited thin films of NH_3, NH_4HS, H_2S, and assignments of absorption bands.** Ferraro, J.R.; Sill, S.; Fink, U. (Argonne National Lab., IL). *Applied Spectroscopy ;* **34**: No. 5, 525-533(1980).

Interferometric ir spectral transmission measurements from 60 to 10,000 cm^{-1} were made for thin films of NH_3, NH_4HS, and H_2S cryodeposits, and recorded as a function of thickness and temperature from 88°K to evaporation points. Integrated band intensities were measured and are reported for all major absorptions. Assignments for lattice and internal fundamental modes are discussed. Particular attention is devoted to the various reported phases of solid NH_3, and it is concluded that three phases are supported by experimental evidence: the stable cubic phase, a low temperature amorphous phase, and an intermediate temperature metastable phase. Results and changes of the spectra as a function of temperature will be summarized. Intercomparisons of the spectra obtained for the three cryodeposits are made. 47 references, 6 figures, 8 tables.

11326 **Asymmetric steady states in catalytic slabs.** Kaper, H.G.; Leaf, G.K.; Matkowsky, B.J. (Argonne National Lab., IL). *Chemical Engineering Science ;* **35**: No. 10, 2195-2201(1980).

The nonlinear problem of a catalyst reacting at its surface has been considered. Using numerical as well as analytical methods all of the steady solutions (symmetric and asymmetric) have been exhibited as a function of the various parameters of the problem. These parameters cause solution branches to shift, to split apart so that solutions are annihilated, and to recombine so that new branches appear. These branches depend quantitatively on the kinetics of the reaction. A particular form of kinetics attributed to

Marek was considered. The results are qualitatively similar for a broad class of reaction models including Langmuir-Hinshelwood and Arrhenius kinetics. The geometry was taken to be a slab. In order to investigate the effects of surface curvature, other geometries, in particular cylindrical and spherical shells, have been considered by a colleague. 4 figures.

11327 **Crystal structure of the β form of $Ni(NO_3)_2.4H_2O$.** Morosin, B. (Sandia Labs., Albuquerque, NM); Haseda, T. Contract AC04-76DP00789. *Acta Crystallographica, Section B. Structural Crystallography and Crystal Chemistry ;* **35**: 2856-2858(1979).

Crystals previously employed for magnetic measurements are shown to be a different form of $Ni(NO_3)_2.4H_2O$. Cell parameters of β-$Ni(NO_3)_2.4H_2O$ are: a = 7.484 (2), b = 10.277 (3), c = 5.476 (1) A, α = 101.06 (3), β = 101.53 (3), and γ = 68.77 (3)° with Z = 2. The space group is P anti 1. Parameters were refined by the least-squares method employing 1934 hkl data to R = 0.049. The two crystallographically different $Ni(NO_3)_2$ $4H_2O$ units are held together by hydrogen bonds. These bonds are believed to be responsible for the small differences observed for the Ni-O bond lengths and the magnetic properties of the two inequivalent Ni^{2+} ions at low temperatures.

11328 **Ionic motion in the defect pyrochlore NH_4TaWO_6.** Butler, M.A.; Biefeld, R.M. (Sandia Labs., Albuquerque, NM). Contract AT(29-1)-789. *Solid State Communications ;* **29**: No. 1, 5-7(1979).

Measurement of both spin-lattice and spin-spin relaxation time for protons in NH_4TaWO_6 suggest rapid ionic motion in this compound. Analysis of the data gives an activation energy of approx. 0.3 eV and an attempt frequency of approx. 1 x 10^{10} sec^{-1}. The data are used to suggest a model for ionic motion which involves movement of individual protons rather than the NH_4^+ ion.

11329 **Pressure dependence of the static dielectric properties of K(H/sub 1-x/D/sub x/$_2PO_4$ and RbH_2PO_4.** Samara, G.A. (Sandia Labs., Albuquerque, NM). Contract AT(29-1)789. *Ferroelectrics ;* **22**: 925-936(1979).

The effects of hydrostatic pressure on the static dielectric constant, ϵ/sub c/, Curie-Weiss constant, C, saturation polarization, P/sub s/, and transition temperature, T/sub c/, of the ferroelectrics K(H/sub 1-x/D/sub x/)$_2PO_4$ and RbH_2PO_4 were investigated. The pressure dependence of T/sub c/ is known from earlier work and the present work extends the results to other deuterium concentrations, x; however, the results on C and P/sub s/ are largely new. An important feature of the results is the strong dependence of the pressure derivatives of these quantities on deuteration. The results are analyzed in terms of the order-disorder and the coupled proton-phonon models. The order-disorder model provides a good account of the results for the heavily deuterated (x approx. equal to 1) crystals but not for the lightly deuterated ones. For the latter crystals the coupled proton-phonon model appears satisfactory. In fact the use of known microscopic parameters and their pressure derivatives in this model provides an essentially quantitative account of the pressure dependences of T/sub c/, C and P/sub s/ of KH_2PO_4. The measurements on two deuterated crystals with x = 0.35 and 0.82 crystals were extended to quite high pressure to examine the possible vanishing of the ferroelectric state as we have observed earlier for KH_2PO_4 and RbH_2PO_4. For the x = 0.35 sample the results indicate that the ferroelectric state vanishes above approx. equal to 3.8 GPa (= 38 kbar) whereas for the x = 0.82 sample a much higher pressure is needed.

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11330 (AD-A—086239) **The molybdenum-molybdenum triple bond. 7.1 bis(1,3-di-p-tolyltriazenido)tetrakis(dimethylamido)dimolybdenum. Technical report.** Chisholm, M.H.; Haitko, D.A.; Huffman, J.C.; Folting, K. (Indiana Univ., Bloomington (USA). Dept. of Chemistry). 9 May 1980. 14p. NTIS, PC A02/MF A01.

Mo2(NMe2)(6) reacts in hydrocarbon solvents with 1,3-di-p-tolyltriazine, C7H8NNNHC7H8, to give the title compound, Mo2(NMe2)4(C7H8N3C7H8)2, as a red, crystalline solid. An X-ray study shows that in the solid state each molybdenum atom is coordinated to four nitrogen atoms which lie in a plane; there is an unbridged molybdenum-to-molybdenum triple bond with a Mo-Mo distance of 2.212(1) angstroms, and the molecule has crystallographically imposed C2 symmetry. Variable temperature 1H nmr spectra recorded at 220 MHz support the view that this form of the molecule is present in solution.

11331 **(DOE/ER/02945—4) Continuous chemical reaction chromatography. Progress report, February 1, 1980-January 15, 1981.** Aris, R.; Carr, R.W. Jr. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). 1981. Contract AS02-76ER02945. 16p. NTIS, PC A02/MF A01.

An experimental investigation of the catalytic dehydrogenation of cyclohexane over Pt/Al_2O_3 (60 to 80 mesh) in a rotating cylindrical annulus continuous chromatographic reactor was completed. A mathematical model of the reactor was developed and used for numerical simulation of reactor performance. Reaction yields in excess of the thermal pot equilibrium were obtained due to the chromatographic separation of the products in the reactor. An investigation of the kinetics of a candidate reaction for the continuous chromatographic reactor, the catalytic dehydration of tert-butyl alcohol over alumina, was initiated and is very nearly completed. A preliminary study of a countercurrent moving bed continuous chromatographic reactor was done, and some aspects of the mathematical theory of countercurrent chromatography were considered.

11332 **(DOE/ER/04446—4) Polymer-based catalysts. Progress report, July 1, 1980-June 30, 1981.** Regen, S.L. (Marquette Univ., Milwaukee, WI (USA)). Feb 1981. Contract AS02-77ER04446. 14p. NTIS, PC A02/MF A01.

Research carried out under this contract period has centered around the following: (1) developing methods for probing active site mobility, macroenvironment, microenvironment and efficiency of triphase catalysts, (2) preparing and evaluating a variety of polyether-based triphase catalysts, (3) synthesizing key monomers from which sequestered ligands are to be prepared, and (4) demonstrating the synthetic utility of simple poly(acrylamide) gels as solid phase cosolvents.

11333 **(DOE/ER/10622—1) Adsorption and desorption of hydrocarbons at low concentrations. Progress report, 1 June 1980-31 December 1980.** Madey, R.; Huang, J.C. (Kent State Univ., OH (USA)). Jan 1981. Contract AC02-80ER10622. 26p. NTIS, PC A03/MF A01.

Research accomplishments during the report period include the following: study of the transport of methane in helium at concentrations from 34 to 100 ppM through an activated carbon adsorber bed; generation of adsorption data for methane, acetylene, and ethane at 25°C for concentrations from 50 ppM to 10,000 ppM; generation of adsorption capacities at 25°C and correlation of the adsorption isotherm for propane at 25°C; study of the transmission of ethane and the asymptotic concentration profile; measurement of the adsorption capacities of ethane and acetylene at 30°C; measurement of the transmission of positive pulses by methane and acetylene for concentrations below 100 ppM; adsorption of binary mixtures.

11334 **(DOE/ER/10625—1) Homogeneous carbon monoxide fixation. Progress report, May 1, 1980-December 31, 1980.** Cutler, A.R. (Wesleyan Univ., Middletown, CT (USA)). Dec 1980. Contract AC02-80ER10625. 13p. NTIS, PC A02/MF A01.

Two carbonyl ligands on $CpFe(CO)_3^+$ (1) have been selectively converted to the C_2 organic molecules ethane, ethylene, methyl or ethyl acetate, or acetaldehyde. $NaBH_3CN$ in methanol or ethanol thus reduces 1 to the alkoxymethyl complexes $CpFe(CO)_2CH_2OR$ [2a, R = Me; b, R = Et]. Alkoxyacetyl complexes $CpFe(CO)L(COCH_2OR)$ [3, L = PPh_3; 4, $P(OMe)_3$], which are derived from 2, then serve as templates for synthesizing other C_2 coordinated ligands. Acidic isomerization of 3, 4 gives the carboalkoxymethyl compounds $CpFe(CO)L(CH_2CO_2R)$; these eliminate alkyl acetate with excess acid. Alternatively, alkylation of 3, 4 affordscetstable α,β-dialkoxyethylidene complexes [e.g., $CpFe(CO)PPh_3[C(OEt)CH_2OMe]^+ PF_6^-$, (7a)] that are activated to

reduction by borohydride reagents. BH_4^- thus produces $CpFe(CO)PPh_3(CH_2CH_3)$ (8), and Et_3BH^- gives $CpFe(CO)PPh_3(CH_2CHO)$ (10). The ethyl complex 8 releases either ethylene by heating or ethane after protonation; the formylmethyl complex 10 eliminates acetaldehyde upon adding acid. Bimetallic activation of 3, 4, by forming μ-acyl complexes $CpFe(CO)L\{CO[Mo(CO)_3Cp]CH_2OR\}^+$, also activates alkoxyacetyl ligand to BH_4^- reduction, giving the ethyl compounds $CpFe(CO)L(CH_2CH_3)$.

11335 (DOE/EV/04959—2) Adducts of PAH carcinogens with DNA. Period covered: September 1, 1979-August 31, 1980. Geacintov, N.E. (New York Univ., NY (USA). Dept. of Chemistry). 1980. Contract AS02-78EV04959. 19p. NTIS, PC A02/MF A01.

One hypothesis for the mechanism of covalent reaction between BPDE (benzo(a) pyrene diol epoxide) and DNA is that this process is preceded by intercalation, i.e., a non-covalent complex formation. If this is the case, it is not clear how the covalent adduct which is subsequently formed, winds up at the external binding site as is observed experimentally. A more attractive hypothesis is that when BPDE is rapidly mixed with DNA, non-covalent binding occurs at both sites I (intercalation) and site II (external); rapid hydrolysis to BPT occurs at site I without covalent bond formation, while covalent adduct formation occurs at site II. The reasons for these differences may well be due to stereo-selective factors for these two types of binding sites. It is evident that additional information will be required to differentiate between these two possibilities.

11336 (DOE/EV/10363—1) Convenient procedure for the syntheses of vinyl iodides via the reaction of iodine monochloride with vinylboronic acids. Kabalka, G.W.; Gooch, E.E.; Hsu, H.C. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1980. Contract AS05-80EV10363. 6p. NTIS, PC A02/MF A01.

Vinyl halides are important synthetic intermediates. One route to vinyl halides involves the reaction of vinylboronic acids with halogens in the presence of sodium hydroxide. Although the reaction of iodine with organoborane reagents has been carefully investigated and is known to produce good yields of stereochemically defined products, it does have two potential disadvantages. The first is the necessity of using a strong base which could react with sensitive functional groups. The second is the fact that one-half of the iodine molecule is lost as iodide which is not economical when radionuclides of iodine are employed. An alternative method of preparing vinyl halides is reported in this paper. Vinyl boronic acids (readily prepared via the hydroboration of alkynes) react with iodine monochloride to yield the corresponding vinyl iodides. This reaction is applicable to a variety of functionally substituted materials. The reaction of triphenylborane with iodine monochloride is also reported.

11337 (UCID—18604) Proposal to realize a cost breakthrough in carbon-13 production by photochemical separation. Marling, J.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1979. Contract W-7405-ENG-48. 13p. NTIS, PC A02/MF A01.

A cost breakthrough can now be made in photochemical production of the rare stable isotope carbon-13. This cost breakthrough is achieved by CO_2 laser infrared multiple-photon dissociation of any of several halocarbons (Freon derivatives) such as CF_3Cl, CF_3Br, or CF_2Cl_2. The single-step carbon-13 enrichment factor for this process is approximately 50, yielding 30% pure C-13 in one step, or up to 97% pure C-13 in two steps. A three-fold carbon-13 cost reduction to below $20/gram is expected to be achieved in a small laboratory-scale demonstration facility capable of producing 4 to 8 kg/year of carbon-13, using presently available pulsed CO_2 TEA lasers at an average power level of 50 watts. Personnel costs dominate the attainable C-13 production costs in a small photochemical enrichment facility. A price reduction to $2/gm carbon-13 is feasible at carbon-13 production levels of 100 to 1000 kg/year, dominated by the Freon raw material costs.

11338 NMR investigations of aggregation of nonionic surfactants in a hydrocarbon medium. Christenson, H. (Univ. of Missouri, Rolla); Friberg, S.E.; Larsen, D.W. *Journal of Physical Chemistry, The ;* **84**: No. 26, 3633-3738(25 Dec 1980).

Proton NMR, carbon-13 NMR, light-scattering, and density measurements were used to investigate association structures and molecular interactions during water solubilization in polyoxyethylene dodecyl ether/benzene systems at high surfactant concentrations. The results indicated an absence of association aggregates at low water concentrations. At water contents between 10 and 20%, association structures started to form, probably micelles of the inverse type, in which the water-polyoxyethylene chain interaction is the predominant feature. There is evidence that the average chain conformation changes with water content, and that bound water molecules are distributed evenly along the polyethoxyethylene chain. At higher water concentration, the results indicated a water-rich core to be formed, supported by the close resemblance of the water properties to these of native water.

11339 IR multiphoton pumping of optically selected levels of the A tilde $^1A_2$ state of thiophosgene. Brenner, D.M. (Brookhaven National Lab., Upton, NY). *Journal of Physical Chemistry, The ;* **84**: No. 25, 3341-3344(11 Dec 1980).

The first excited singlet state of thiophosgene is IR multiphoton pumped from state-selected vibronic levels of increasing vibrational energy, E/sub vib/. The extent of IR pumping to nonradiative (predissociating) levels is monitored from total fluorescence. The latter is observed to decrease due to IR pumping but no obvious dependence on E/sub vib/ of the initial state is observed. However, at levels requiring absorption of only one IR photon, unexpectedly little or no change in total fluorescence is observed suggesting that the absorption coefficient of these levels may be much smaller than at lower levels.

11340 Mechanism of ejection of organic molecules from surfaces by keV ion bombardment. Garrison, B.J. (Pennsylvania State Univ., University Park). Contract W-7405-ENG-48. *Journal of The American Chemical Society ;* **102**: No. 21, 6553-6555(8 Oct 1980).

The nuclear motion in the solid, is examined, that can lead to the ejection of fragments. Three factors from theoretical calculation that favor ejection of molecular fragments were included. The ejection mechanisms were examined with a classical dynamics procedure. The factors leading to the ejection of molecular fragments from ion-bombarded solids are (1) the energy of the chemical bond strength by multiple collisions in the solid, (2) the molecular fragments can eject intact since there are many internal vibrational modes which can absorb energy from an energetic collision and (3) multiple atoms can be struck by a larger substrate atom forcing them to move in a concerted fashion. 2 figures. (DP)

11341 Theoretical models for transition-state structure and catalysis in carbonyl addition. Williams, I.H. (Univ. of Kansas, Lawrence); Spangler, D.; Femec, D.A.; Maggiora, G.M.; Schowen, R.L. Contract W-7405-NG-48. *Journal of The American Chemical Society ;* **102**: No. 21, 6619-6621(8 Oct 1980).

The formation of methanediol from water and formaldehyde is suggested by ab initio self-consistent field molecular orbital calculations at the 4-31G level to be a quite difficult process passing through a transition state for simultaneous proton transfer and carbon-oxygen bond format. A significant feature of the transition-state structure is the presence of an essentially planar four-membered ring formed between the O-H band of the attacking water molecule and the C-O bond of formaldehyde. The water is oriented in such a fashion to enable one of its lone pairs to align approximately along the newly forming O-C bond. A rather large activation energy of 44.1 kcal mol^{-1} exists for water-formaldehyde addition, and the reaction is exothermic by 16.8 kcal mol^{-1}. Examination of the transition-state vibrational mode corresponding to the imaginary frequency (ν = i1996.6 cm^{-1}) indicates that the dominant motion is an approximately clockwise rotation of the water molecule about its oxygen atom in the plane of the four-membered ring, coupled to a transfer of the ring proton. The resistance to adduct formation may be removed by either prior protonation of

formaldehyde or prior deprotonation of water. The greater ease of adduct formation corresponds to specific acid catalysis and specific base catalysis. 2 figures. (DP)

11342 **Isotope enrichment systems.** Spevack, J.S. (to Deuterium Corp.). US Patent 4,221,774. 9 Sep 1980. Filed date 6 Aug 1976. vp.

A new combination is disclosed of (I) a process for producing a substance enriched in a desired isotope of hydrogen and/or oxygen from a flow of liquid substance, e.g., water which becomes depleted in its content of said isotope, and (II) replenishing the liquid substance with said isotope by (A) direct contact with a flow of steam from a source external to the process, preferably geothermal steam, and (B) supplying feed flow of the process (I) from the so replenished liquid substance. Modes of improving the various forms of the process which employ dual temperature isotope exchange and their sub-combinations are also disclosed which enable high temperatures and/or greater tower temperature differentials to be employed at reduced pressure, thus decreasing construction, energy, and other operating costs of the process, by the use in the process of certain hydroxylated and/or carboxylated organic compounds preferably with a minor proportion of water and preferably having in solution an ionizable substance enhancing the isotope exchange.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 10999, 11317, 11362

11343 **(AD-A—086691) Investigation of electrochromic diphthalocyanines. Final report 1 Apr 77-31 Mar 80.** Nicholson, M.M.; Galiardi, R.V.; Pizzarello, F.A.; Layman, G.A. (Rockwell International Corp., Anaheim, CA (USA). Electronics Research Div.). Jun 1980. 40p. NTIS, PC A03/MF A01.

Lanthanide diphthalocyanine films on tin oxide electrodes in contact with aqueous electrolytes exhibit a series of color changes on variation of the applied potential. The results confirmed that the color changes were due to faradaic reactions rather than temporary field effects. They provided information on the stoichiometry and kinetics of the electrode processes and on the stabilities of color-converted forms of the dye. The lutetium diphthalocyanine film was initially green. By simple chemical and electrochemical diagnostic experiments, it was found that a blue cathodic product formed with utilization of hydrogen ion. The blue material was converted to green by reaction with oxygen. Anodic reactions could produce more than one red form of the dye, generally without a pH change in the electrolyte. The red materials were strong oxidizing agents. Thin-layer electrochemical measurements confirmed the participation of protons in the cathodic process. The thin-layer cell design, which included a shallow, precisely etched glass cavity, may prove useful in other research. A complementary solid-state electrochemical investigation of lutetium diphthalocyanine in this laboratory led to the proposal that anodic oxidation occurred by rapid migration of anions from the electrolyte into the solid organic film.

11344 **(LBL—11694) Modeling of changing electrode profiles.** Prentice, G.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., Berkeley (USA). Dept. of Chemical Engineering). Dec 1980. Contract W-7405-ENG-48. 233p. NTIS, PC A11/MF A01.

Thesis.

A model for simulating the transient behavior of solid electrodes undergoing deposition or dissolution has been developed. The model accounts for ohmic drop, charge transfer overpotential, and mass transport limitations. The finite difference method, coupled with successive overrelaxation, was used as the basis of the solution technique. An algorithm was devised to overcome the computational instabilities associated with the calculations of the secondary and tertiary current distributions. Simulations were performed on several model electrode profiles: the sinusoid, the rounded corner, and the notch. Quantitative copper deposition data were obtained in a contoured rotating cylinder system. Sinusoidal cross-sections, machined on stainless steel cylinders, were used as model geometries. Kinetic parameters for use in the simulation were determined from polarization curves obtained on copper rotating cylinders. These parameters, along with other physical property and geometric data, were incorporated in simulations of growing sinusoidal profiles. The copper distributions on the sinusoidal cross-sections were measured and found to compare favorably with the simulated results. At low Wagner numbers, the formation of a slight depression at the profile peak was predicted by the simulation and observed on the profile. At higher Wagner numbers, the simulated and experimental results showed that the formation of a depression was suppressed. This phenomenon was shown to result from the competition between ohmic drop and electrode curvature.

11345 **(LBL—11849) Bubble dynamics at gas-evolving electrodes.** Sides, P.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., Berkeley (USA). Dept. of Chemical Engineering). Dec 1980. Contract W-7405-ENG-48. 159p. NTIS, PC A08/MF A01.

Thesis.

Oxygen was evolved on a transparent tin oxide window electrode and the events were viewed from the backside. Movies showed that coalescence of bubbles determines the size of bubbles and the chain of transport processes; growth by diffusion and by coalescence proceeds in series and parallel; coalescing bubbles cause significant fluid motion close to the electrode; bubbles can leave and reattach; and bubbles evolve in a cycle of growth by diffusion and different modes of coalescence. An analytical solution for the primary potential and current distribution around a spherical bubble in contact with a plane electrode is presented. Zero at the contact point, the current density reaches only 1% of its undisturbed value at 30% of the radius from that point and goes through a shallow maximum two radii away. The solution for spherical bubbles applies for the small bubbles of electrolytic processes. The incremental resistance in ohms caused by sparse arrays of bubbles is given by $\Delta R = 1.352\ af/kS$, where f is the void fraction of gas in the bubble layer, a is the bubble layer thickness, k is the conductivity of gas free electrolyte, and S is the electrode area. A densely populated gas bubble layer on an electrode was modeled as a hexagonal array of dielectric spheres. As lucite spheres were placed in one end of a hexagonal cell, the resistance as a function of gas bubble layer packing density sharply increased as close packing was approached. The Distribution Model of Meredith and Tobias, derived for 3-D gas dispersions, approximately predicted the conductivity of a bubble layer at void fractions > 0.3.

11346 **(UCRL—15320) Catalyzed air electrodes. Final report.** Laitinen, H.A. (Florida Univ., Gainesville (USA). Dept. of Chemistry). 1980. Contract W-7405-ENG-48. 22p. NTIS, PC A02/MF A01.

Several methods of platinization of tin oxide were compared. Two types of supporting materials, glass and silicon wafers lightly coated with SiO_2, were used. Platinization was carried out by electrodeposition from aqueous solution, electrodeposition from platinum (II) acetylacetonate in non-aqueous solution, thermal decomposition of platinum (II) acetylacetonate, and chemisorption from aqueous solution followed by thermal decomposition. The electrodeposition methods and thermal decomposition all yielded platinum crystallites, but the chemisorption method gave dispersions approaching unity. All preparations showed catalytic activity for the electro-reduction of oxygen, but the most efficient from the view point of economy of platinum utilization was the chemisorption method. Stability tests indicated that preparations containing less than monolayer equivalent amounts of platinum were exceptionally stable to 5M KOH at 50°. Under more severe conditions (9M KOH at 90°) the SnO_2 layer was etched and Pt loss occurred under open-circuit conditions. Further work is recommended, especially on the chemisorption method, because only this method offers promise of avoiding the formation of platinum crystallites and taking advantage of possible substrate-platinum interactions to enhance the catalytic action of fractional monolayers of platinum. Further work on stability in stronger alkaline solutions is also recommended.

11347 **Process for oxidizing vanadium and/or uranium .** Brunsell, D.A.; Riggs, O.L. (to Kerr-Mcgee Corp). US Patent 4,222,826. 16 Sep 1980. Filed date 10 Oct 1978. vp.

The present invention provides a process for rapidly and efficiently oxidizing either or both vanadium and uranium from the

trivalent and guadrivalent oxidation states, respectively, to the pentavelent and hexavalent oxidation states, respectively, through the use of a special electrode. The electrode is produced by anodically treating a substrate material selected from the group of titanium, zirconium, niobium, hafnium and alloys thereof in an aqueous electrolyte. The electrolyte comprises an aqueous solution of manganous ion in a concentration of from about 15 to 50 gm/l and from about 10 to 40 gm/l sulfuric acid. Manganese dioxide is electrodeposited on the substrate to form the electrode. The manganese dioxide coated electrode then is placed in an oxidation cell as an anode wherein it is potentiostaticly controlled to oxidize either or both vanadium and uranium without significant anode deterioration and without oxygen generation at the anode.

4005 Photochemistry

11348 (COO—2026-40) Studies in chemical reactivity. Progress report, January 1-December 31, 1980. Carr, R.W. Jr. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). 1980. Contract AS02-76ER02026. 33p. NTIS, PC A03/MF A01.

Measurements of some product quantum yields from the photolysis of 1,3-dichlorotetrafluoroacetone in the presence of oxygen have been done. An investigation of the flash photolysis of ketene, using time resolved mass spectrometry to monitor intermediates and products, has been initiated. A re-design of the apparatus for flash photolysis with time resolved mass spectrometry has been accomplished, and construction of components nearly completed. The modifications will permit a gain of about 10^3 in detection sensitivity. An apparatus for highly sensitive detection of laser excited luminescence has been built.

11349 (DOE/ER/04685—1) Photochemical activation and reactivity of polynuclear transition metal complex molecules. Progress report, June, 1980-May 31, 1981. Endicott, J.F.; Lintvedt, R.L. (Wayne State Univ., Detroit, MI (USA)). Jan 1981. Contract AS02-78ER04685. 18p. NTIS, PC A02/MF A01.

Progress on this project during the past year has proceeded in three different but complementary directions. The first involves a continuing effort to synthesize new and unusual polynuclear transition metal complexes that (1) exhibit multi-electron transfer reactions, (2) can be expected to have long-lived excited states, and/or (3) will undergo photochemically initiated intramolecular energy transfer to produce reactive species. The second involves the electrochemical investigation of multi-electron transfer reactions of polynuclear transition metal complexes. The third is concerned with the study of the photophysics of binuclear complexes in which electron transfer could take place between a photochemically excited metal ion and the metal ion in the same molecule thereby producing two new reactive sites.

11350 Energy-transfer studies using doublet-state acceptors. Quan, N.N.; Guzzo, A.V. (Univ. of Wyoming, Laramie). Contract AT-11-1627. *Journal of Physical Chemistry, The ;* **85**: No. 2, 140-144(22 Jan 1981).

Energy transfer of the Foerster or dipole resonance type was observed between a number of excited triplet-state donors and several ground-state doublet nitroxyl radicals. The transfer was measured by observing the phosphorescence quenching of the donors and by measuring the rates of radical decay by ESR. Critical transfer distances of the order of 12 to 20 A were measured for these systems, and the values obtained agree with those calculated via Foerster's equation.

11351 Mediated photochemical oxidative dimerization. Fox, M.A.; Owen, R.C. (Univ. of Texas, Austin). *Journal of The American Chemical Society ;* **102**: No. 21, 6559-6561(8 Oct 1980).

A comparison of the photochemistry of the tetraphenylcylopentadienyl anion and the fluorenyl anion in aprotic solvents in homogeneous solution and at the surface of a semiconductor electrode was reported. These experiments represented a new route for a visible-light induced dimerization of their hydrocarbon precursors, and an unexplored method for establishing a mechanism in the photolysis of easily oxidized organic compounds. (DP)

4006 Radiation Chemistry

11352 Radiolytic production of trapped hydrogen atoms from organic compounds in Xe, Kr, and Ar at 10 K. Bhattacharya, D.; Willard, J.E. (Univ. of Wisconsin, Madison). Contract EY-76-S-02-1715-A003. *Journal of Physical Chemistry, The ;* **85**: No. 2, 154-159(22 Jan 1981).

Trapped hydrogen atoms (H/sub t/ or D/sub t/) are shown to be formed by the radiolysis at 10 K of 0.5 mol % of CH_4, C_2H_6, 3-methylpentane-h_{14} (3MP), 3-methylpentane-d_{14} (3MP-d_{14}), benzene, C_2H_5OH, or i-C_4H_{10} in Xe, of 3MP-d_{14} in Kr, and of C_2H_6 or 3MP-d_{14} in Ar. This is consistent with the conclusion that the reason trapped atoms are not observed following similar radiolyses of neat organic compounds is because they are lost by prompt abstraction from C-H (or C-D) bonds. If no H/sub t/ or D/sub t/ were produced from the organic compounds in the inert gas matrices it would have been necessary to conclude that radical formation during radiolysis of neat organic solids occurs by proton transfer. The magnitudes of the trapped atom yields in the inert gas matrices require a contribution to bond rupture by transfer of energy or charge from the inert gas molecules to the organic species over several molecular diameters. The evidence indicates that, at least in the case of CH_4 in Xe, the transfer mechanism involves photon emission by excited matrix molecules and absorption by the organic solute molecules. The thresholds for the onset of decay of H/sub t/ occur at about 20 K in Ar, 30 K in Kr, and 40 K in Xe. In part at least, the decays follow second-order kinetics. The trapped radicals in Xe require a temperature of $>$ 100 K for rapid decay. At doses $>$ 1 x 10^{20} eV g^{-1} the G(H/sub t/) in Xe-3MP decreases, and a steady-state plateau concentration of — 5 x 10^{-3} M appears to be reached at — 6 x 10^{20} eV g^{-1}. Possible mechanisms of the C-H (C-D) bond rupture are discussed. Equipment designed for prompt ESR examination of samples x irradiated at $\cong$ 8 K and the nature of corrections for photoelectric absorpton of the x rays are described.

11353 Spectroscopic studies of phenylcyclohexadienyl radicals in the irradiated biphenyl crystal. Nakayama, T. (Univ. of Notre Dame, IN); Sheng, S.J.; Takagi, K. *Journal of Physical Chemistry, The ;* **85**: No. 2, 174-178(22 Jan 1981).

Absorption and laser-induced fluorescence of phenylcyclohexadienyl radicals in an irradiated biphenyl crystal have been measured at 4.2 K. The origin of the lowest electronic transition of the radical is located at 6604 A. It was shown that the radical produced in the irradiated crystal is most probably a 2- or 4-hydrogen adduct radical, a phenylcyclohexadienyl radical, from the analysis of the vibrational frequency, from an ESR spectrum, and from the results of SCF-CI MO calculation.

11354 Catalysis of methyl viologen radical reactions by polymer-stabilized gold sols. Meisel, D.; Mulac, W.A.; Matheson, M.S. (Argonne National Lab., IL). *Journal of Physical Chemistry, The ;* **85**: No. 2, 179-187(22 Jan 1981).

The catalysis of methyl viologen radical cation ($MV^{+\cdot}$) decay reactions by gold sol, stabilized by either poly(vinyl sulfate) (PVS) or poly(vinyl alcohol) (PVA), was studied by pulse radiolysis. Stabilization of the sol by PVS eliminates the hydrogen evolution reaction as a pathway for $MV^{+\cdot}$ decay. This is shown to be due to dimerization of $MV^{+\cdot}$ (to the biradical) in the potential field of the polyelectrolyte. On PVA-stabilized sols, the hydrogen evolution reaction is a major pathway although side reactions (probably hydrogenation) interfere to a large extent. The rate of adsorption of $MV^{+\cdot}$ on PVA-stabilized sol is controlled by the diffusion of $MV^{+\cdot}$ to the gold particle. Subsequent reactions of protonation and electrochemical desorption, (Au)/sub c/sup n/ $^-$H/sub m/ + $H_3O^+ \rightarrow$ (Au)/sub c//sup (n-1)-/H/sub m-1/ + H_2 + H_2O, on a slower time scale are the rate-determining steps at the pH range and catalyst concentration used. At higher catalyst concentrations interparticle reaction is invoked to explain the dependence on [Au].

11355 **Redox reactions of dioxygen complexes of cobalt(III) with organic radicals studied by pulse radiolysis.** Natarajan, P.; Raghavan, N.V. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry, The ;* **85**: No. 2, 188-191(22 Jan 1981).

Reduction processes of μ-superoxo complexes of cobalt(III), $[(NH_3)_4Co(\mu O_2, \mu NH_2)Co(NH_3)_4]^{4+}$, 1, $[(en)_2Co\text{-}(\mu O_2, \mu NH_2)Co(en)_2]^{4+}$, 2 (en = ethylenediamine), $[(CN)_5Co(\mu O_2)Co(CN)_5]^{6-}$, 3, with the formate radical, the alkyl hydroxy radicals CH_2OH, CH_3CHOH, $(CH_3)_2COH$, and $(CH_3)COH$ and the solvated electron were investigated. Reduction of these complexes occurs at the dioxygen center and the products of the reduction are determined to be the corresponding μ-peroxo complexes. The reduction of complexes 2 and 3 by the solvated electron is studied and the biomolecular rate constant for the reduction of 2 is higher by two orders of magnitude than that for the reduction of 3. The same behavior is observed for the reaction of these μ-superoxo complexes with the formate radical, indicating that the effect is due to the presence of the 4+ charge in 1 and 2 and the 5- charge in 3. The isopyropyl radical reacts with the μ-superoxo cobalt(III) complexes faster than CH_2OH and C_2H_4OH radicals. The product observed for the reduction of the μ-superoxo amine complexes by the isopropyl radical appears to be an isomer of the peroxo complex. It is proposed that the reaction of the isopropyl radical with the superoxo complexes proceeds in part by involving the metal center.

11356 **Track effects in radiation chemistry. Concentration dependence for the scavenging of OH by ferrocyanide in N_2O-saturated aqueous solutions.** Schuler, R.H.; Hartzell, A.L.; Behar, B. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry, The ;* **85**: No. 2, 192-199(22 Jan 1981).

The radiation chemical yield for oxidation of ferrocyanide by OH produced in the fast electron radiolysis of N_2O-saturated aqueous solutions is found to increase from a low concentration limiting yield of 5.2 to values in excess of 6.7 for ferrocyanide concentrations above 0.1 M. This observed dependence reflects competition between the scavenging reaction and track recombination processes involving OH radicals which occurs on a time scale greater than 10^{-9}s. By extrapolation an additional yield of — 1.5 is estimated for OH radicals which recombine at still shorter times. These scavenging studies show that significant amounts of recombination occur within the track even at times as long as 10^{-6}s. Secondary radicals produced within the track are also subject to recombination processes as is illustrated by the low concentration limit which shows that most OH radicals produced from N_2O within the track do not escape from the track. In general, for concentrations of reactive solutes greater than — 10^{-4} M, i.e., for $k[S] > 10^6\ s^{-1}$, scavenging of OH from the track will contribute significantly to the observed yields and this effect must be taken into account in comparing the results from different radiolytic systems.

11357 **Pulse radiolysis studies concerning the reactions of hydrogen abstraction from tetraalkylammonium cations.** Bobrowski, K. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry, The ;* **84**: No. 26, 3524-3529(25 Dec 1980).

The rate constants for reactions of hydroxyl(OH), sulfate (SO_4^-), phosphate (HPO_4^-), and chloride radicals (Cl_2^-) with the first four homologues of tetraalkylammonium cations were determined by the spectrophotometric pulse radiolysis method. The reactivity of tetraalkylammonium cations toward these radicals increases with increasing number of C-H bonds in the molecule. Intercomparison of the rate constants for the different radicals shows a trend characteristic for a mechanism involving hydrogen abstraction, e.g., k/sub $OH+R_4N^+$ > k/sub $SO_4^- + R_4N^+$ > k/sub $HPO_4^- + R_4N^+$/ > k/sub $Cl_2^- + R_4N^+$. The ratios of the reactivities are in good agreement with those reported for other aliphatic compounds which undergo hydrogen abstraction. The reactivities of long-chain tetraalkylammonium cations are the sum of the partial reactivities of C-H bonds at different positions in the molecules, indicating that the reaction of OH radicals with these cations involves the abstraction of H atoms in the rate-determining step. The partial reactivity for hydrogen abstraction from carbon atoms adjacent to the nitrogen center is nearly two orders of magnitude less than for comparable groups in aliphatic hydrocarbons. Influence of the nitrogen center extends even to the β position where partial rate constants are a factor ~ 5 less.

11358 **Radiation chemistry of heavy-particle tracks. I. General considerations.** Magee, J.L.; Chatterjee, A. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Journal of Physical Chemistry, The ;* **84**: No. 26, 3529-3536(25 Dec 1980).

The radiation chemistry of heavy-particle tracks in dilute aqueous solution is considered in a unified manner. Emphasis is on the physical and chemical phenomena which are involved rather than on the construction of models to be used in actual calculations although the latter problem is discussed. A differential segment of a heavy-particle track is composed of two parts which we call core and penumbra; elementary considerations show that all properties of such a differential track can be uniquely specified in terms of a two-parameter system, and we choose energy per nucleon (E) and atomic numbers (Z) as independent parameters. The nature of heavy-particle-track processes varies with the magnitude of the energy deposit (LET), and we discuss three categories of track problems, for low-, intermediate-, and high-LET cases, respectively. Scavenger reactions normally terminate radical recombination in a track, and for heavy-particle tracks we find a criterion involving the scavenger concentration for a convenient separation of core and penumbra into essentially noninteracting parts which can be treated independently. Problems of the core expansion in the three regions are considered, and it is found that a versatile model can be constructed on concepts previously introduced by Ganguly and Magee. A model for the penumbra, based on the authors' electron-track theory, is presented and discussed.

11359 **Radiation chemistry of heavy-particle tracks. II. Fricke dosimeter system.** Chatterjee, A.; Magee, J.L. (Univ. of California, Berkeley). *Journal of Physical Chemistry, The ;* **84**: No. 26, 3537-3543(25 Dec 1980).

A heavy-particle-track model suggested by considerations presented in a companion paper is used in a calculation of the differential (G') and integral (G) yields of the Fricke dosimeter system for six selected particles over a wide range of energies. The particles are H, He, C, Ne, Ar, and Fm; the energy range for the first two is 10^{-3}-10^{3} MeV/n, and for the last four is 10^{-1}-10^{3} MeV/n. The calculated G' and G values are compared with experimental values as far as possible, and the heavy-particle-track model situation is discussed.

11360 **Direct observation of the protonation of acetone ketyl radical by conductometric pulse radiolysis.** Janata, E.; Schuler, R.H. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry, The ;* **84**: No. 25, 3351-3353(11 Dec 1980).

Improvements in conductometric pulse radiolysis methods allow direct observation of the protonation of the acetone ketyl radical anion on the 10-ns time scale. The protonation period of 9.7 +- 0.5 ns determined here is in good agreement with that estimated from the ESR line broadening studies of Laroff and Fessenden, [J. Phys. Chem., 77, 1283(1973)].

11361 **Phase effects in the radiation chemistry of dl-camphor.** Klingen, T.J.; Sherman, L.R.; McCormick, D.G. (Univ. of Mississippi, University). Contract EY-76-S-05-3781. *Journal of Physical Chemistry, The ;* **84**: No. 25, 3451-3455(11 Dec 1980).

The effect of mesomorphism on the radiation chemistry of the solid state is examined for the system dl-camphor, which has only a small entropy difference between the α and β mesophases. The results of the radiolysis of these phases gave rise to the same products in both mesophases but with differences in the product G values in the two mesophases. These results are discussed in terms of the effect of phase on the overall mechanism for the formation of the observed products, which can be attributed to efficient abstraction reactions operative in the β phase but not the α phase.

11362 **Electrochemical reactions of some organic free radicals at colloidal silver in aqueous solution.** Henglein, A. (Hahn-Meitner-Institut fuer Kernforschung Berlin GmbH, Germany). *Journal of Physical Chemistry, The ;* **84**: No. 25, 3461-3467(11 Dec 1980).

Electron-transfer processes between simple 1-hydroxyalkyl, 1-ethoxyethyl, and 2-hydroxycyclohexadienyl radicals and metal ions at the surface of colloidal silver are described. C_6H_6OH radi-

cals are oxidized by Ag^+ to yield phenol. In the absence of Ag^+, no electron exchange between C_6H_6OH and the silver particles takes place. When the silver particles carry a tiny deposit of thallium metal, the C_6H_6OH radicals are reduced. Cu^+ (and Cu^{2+}) ions adsorbed on the silver particles oxidize C_6H_6OH radicals. However, reduction of C_6H_6OH by Cu^+ occurs, if the silver particles are covered with copper metal. 1-Hydroxyalkyl and 2-ethoxyethyl radicals reduce Tl^+ ions in the presence of colloidal silver, but oxidize Tl atoms in homogeneous solution. Water can be decomposed to yield H_2 by 1-hydroxy-1-methyl and 1-hydroxyethyl, but not by 1-hydroxymethyl, 1-ethoxyethyl, and 2-hydroxycyclohexadienyl radicals. These findings are discussed in terms of standard potentials for the oxidation and reduction of the radicals and in terms of distributions of occupied and unoccupied electronic redox levels in the radicals and the colloidal metal. In these experiments γ radiolysis was used to produce the radicals at a controlled rate.

11363 Reanalysis of the ESR spectrum of the triethylarsine dimer radical cation (Et_3As-$AsEt_3^+$). Hudson, R.L. (Eckerd Coll., St. Petersburg, FL); Williams, F. *Journal of Physical Chemistry, The ;* **84**: No. 25, 3483-3485(11 Dec 1980).

The dimer radical cation $As_2Et_6^+$ has been generated by γ irradiation of triethylarsine, and its ESR spectrum interpreted as the full 16-line ^{75}As pattern expected when higher-order effects are important. The ESR parameters result in spin densities which establish that the unpaired electron is largely localized between the two arsenic atoms in $As_2Et_6^+$.

11364 Mean energy deposition distribution about proton tracks. Mills, R.E. (Brookhaven National Lab., Upton, NY); Rossi, H.H. Contract EP-78-5-02-4733;EY-76-C-02-0016. *Radiation Research ;* **84**: No. 3, 434-443(Dec 1980).

The radial distribution of the mean energy deposited by delta rays produced along proton tracks has been studied with the use of a segmented ionization chamber having nearly transparent collection volume boundaries formed by fine wire grids. Measurements were made for proton energies ranging from 0.5 to 4.0 MeV and simulated tissue radii from about 1 nm to 1 μm. Close agreement was found with previous theoretical and experimental determinations by several authors.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 11024, 11025, 11026, 11027, 11028, 11029, 11031, 11032, 11033, 11347, 11349, 11584, 11615

11365 (AD-A—087354) Electron linear accelerator production of oxygen-15. Weitz, R.L.; Casady, J.T. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). Dec 1979. 9p. NTIS, PC A02/MF A01.

An electron linear accelerator was used to produce gaseous oxygen-15 by bremsstrahlung irradiation of hydrogen peroxide-water solutions. With helium as a sweep gas, it was possible to achieve oxygen-15 activities of 24 mCi per liter of gas. Carbon-11, the only detectable radioactive contaminant, constituted less than 0.2% of the activity when 30-MeV electrons were used. Transfer of oxygen-15 to blood by a simple bubbling technique resulted in blood activities of about 85 micro Ci/cc of blood.

11366 Bond dissociation energies of C-H bonds in several haloethylenes, as estimated from the recoil tritium abstraction reaction. Steinkruger, F.J.; Rowland, F.S. (Univ. of California, Irvine). Contract DE-AT03-76ER-70126. *Journal of Physical Chemistry, The ;* **85**: No. 2, 136-140(22 Jan 1981).

The abstraction yields from the reaction $T + RH \rightarrow HT + R$ have been measured for a series of haloethylenes under standard conditions in an excess of C_2D_4. The tritium atoms have been produced with excess energy from the nuclear reaction $^3He(n,p)T$. The order of decreasing HT yield per C-H bond is cis-CHCl=CHCl > cis-CFCl=CHCl > $CH_2 = CH_2 \simeq CF_2$=CHCl > cis-CHF=CHF $\simeq CF_2=CH_2 > CF_2$=CHF. The C-H bond dissociation energies of these compounds can be estimated from these yields and range relative to C-H in C_2H_4 from -2 kcal/mol, for cis-CHCl=CHCl to +2 kcal/mol for CF_2=CHF. With the current value of 109 +- 1 kcal/mol for the bond dissociation energy of ethylene, these values for the halothylenes fall in the range from 107 to 111 kcal/mol.

11367 (LA—8577-PR, pp 63-69) Organic Chemistry Group (LS-5). Oct 1980.

In Biomedical and Environmental Research Program of the LASL Life Sciences and Health Divisions. Progress report, January-December 1979.

The Organic Chemistry Group concentrates on the synthesis of isotopically labeled compounds. We utilize two approaches to the synthesis of labeled compounds - chemical syntheses and biochemical syntheses. Labeled compounds prepared in the synthesis program can be made available to outside investigators through the Natural Stable Isotopes Resource (SIR), which has been established at LASL by the National Institutes of Health. Our current project in stereoselective syntheses of amino acids is in determining the labeled compounds most pertinent to research in the life sciences. In addition, there are two areas that are part of the oil shale program. One project is concerned with the prenatal toxicology of oil shale product water. The second project is concerned with the analytical chemistry of oil shale.

11368 (ORNL/TM—7358) Calculated equilibria between adjacent valence states of plutonium in simple aqueous solutions. Sweeton, F.H. (Oak Ridge National Lab., TN (USA)). Feb 1981. Contract W-7405-ENG-26. 22p. NTIS, PC A02/MF A01.

Equilibrium data have been taken from the literature for the oxidation of Pu^{3+} to Pu^{4+}, Pu^{4+} to PuO_2^+ and PuO_2^+ to PuO_2^{2+}, and for the hydrolysis of these four plutonium species in dilute solutions. These data have been used to calculate the oxidation-reduction potentials (expressed as E/sub h/) at which the concentrations of the two species (including the hydrolyzed forms) in each pair are equal. These calculations cover the pH range of 0 to 13. The results indicate that there are conditions under which each species can be predominant. The solubility of PuO_2 under environmental conditions is also discussed.

11369 Synthesis of [^{18}F]-5-fluorouridine (f-18-5-FUR) as a probe for measuring RNA synthesis and tumor growth rates in vivo. Shiue, C.Y.; Fowler, J.S.; MacGregor, R.R.; Wolf, A.P. (Brookhaven National Lab., Upton, NY). pp 260-264 of Radiopharmaceuticals II: proceedings of the second international symposium on radiopharmaceuticals. New York, NY; Society of Nuclear Medicine (1979).

A method for the rapid synthesis of high specific activity of [^{18}F]-5-fluorouridine is described. The $^{20}Ne(d,\alpha)^{18}F$ nuclear reaction is used to produce high specific activity, anhydrous [^{18}F]-F_2 at the Brookhaven National Laboratory 60" cyclotron. Fluorination of 2',3',5'-tri-O-acetyluridine with [^{18}F]-F_2 in glacial acetic acid at room temperature followed by hydrolysis with sodium methoxide in methanol gives [^{18}F]-5-fluorouridine with a radiochemical yield of 5-7% in a synthesis time of 90 minutes from EOB. The compound is required for the study of RNA synthesis and tumor growth rates in vivo.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

11370 (AD-A—086376) Arrhenius systems: dynamics of jump due to slow passage through criticality. Technical summary report. Kapila, A.K. (Wisconsin Univ., Madison (USA). Mathematics Research Center). Mar 1980. 34p. NTIS, PC A03/MF A01.

Reactive systems involving Arrhenius kinetics often exhibit multiple steady states. A typical response is an S-curve, whose turnaround points correspond to ignition or extinction. This paper describes the dynamics of transition from the extinguished to the ignited state as the reaction-rate parameter is slowly varied through the critical value. Both lumped and spatially distributed models are studied. The asymptotic analysis is based on the largeness of two parameters: one characterizing the activation energy and the other the slow passage.

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4201 General Engineering

11371 **(DOE/TIC—11392) Phase XIV: the thirteenth annual national survey of compensation paid to scientists and engineers engaged in research and development activities in the United States.** Newborg, J.; Gabel, J.; Beatty, G.H.; Spurgeon, M.; Newman, S. (Battelle Columbus Labs., OH (USA)). 24 Dec 1980. Contract W-7405-ENG-92. 50p. NTIS, PC A03/MF A01.

The Thirteenth Annual National Survey of Compensation Paid to Scientists and Engineers Engaged in Research and Development in 1980 is summarized. The contract scope of work specified that the survey should obtain information concerning compensation and compensation-related characteristics of both nondegreed and degreed scientists and engineers engaged in research and development. Information was to be obtained concerning both the employees and employers. The survey variables for which information was to be obtained were specified. As before, the universe specifications were to encompass industrial establishments, educational institutions, nonprofit research institutes, federal laboratories, and federally funded research and development centers. The sampling plan was to be the same as for the previous surveys. The sample size was to be maintained at approximately 300 to 325 establishments. The sampling plan incorporated stratification and clustering based upon (a) establishment size in terms of numbers of scientists and engineers employed and (b) size of the Standard Metropolitan Statistical Area (SMSA) in terms of scientists and engineers in the area. Trend analyses, showing changes in salary levels over a five-year period, were to be prepared.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 10236, 10354, 10907, 10925, 11470, 11682, 11800

11372 **(AD-A—086466) Integrated thin film dc SQUIDS. Final report Nov 76-Oct 79.** Donaldson, G.B. (Strathclyde Univ., Glasgow (UK). Dept. of Applied Physics). Oct 1979. 26p. NTIS, PC A03/MF A01.

A new thin film low temperature facility has been developed and used for work on three aspects of DC SQUIDS. First, ellipsometric studies have been made of the process of RF sputter-etch oxidation of Pb-In alloys and of Nb. Second, structures based on Nb-NbOx-Pb/In Josephson junctions have been produced and successfully operated as planar SQUIDs with a flux noise of 0.000085 Phi sub o sq rt Hz. Finally, all Nb structures, based on Nb-NbOx/Au-Nb junctions, have been operated as SQUIDs though so far with inferior noise performance (0.05 Phi sub o sq rt Hz). Work is proceeding on the production of integrated magneometric structures using photolithographic techniques to etch planar flux-transformers and the associated components.

11373 **(AD-A—086494) A study of low-temperature processes in non-equilibrium electronic states. Final report FEb 78-Jan 80.** Wang, T.C.; Magee, T.J.; Peng, J.; Armistead, R.A. (Advanced Research and Applications Corp., Sunnyvale, CA (USA)). Apr 1980. 58p. NTIS, PC A04/MF A01.

Primary focus was directed to experimental studies of the electrical behavior of weakly-coupled superconductors. Two types of superconducting devices were used, Josephson tunnel junctions and superconducting thin-film microbridges. The experiments showed that non-equilibrium states created by microwave irradiation and quasiparticle injection will change the current - voltage characteristics of Josephson devices. Experiments were also conducted to determine if the grain size of superconducting niobium (Nb) films could be controlled using scanning laser annealing. Initial (as deposited) grain sizes were dependent upon the deposition technique. Regardless, laser annealing resulted in substantial modifications to the structure of the Nb films. With proper laser annealing techniques, relatively fine-grained polycrystalline films were converted to large polycrystalline grains with an average size of 5 by 10 micrometers.

11374 **(AD-A—086527) Power losses in liquid metal current collectors. Final report Oct 78-Mar 80.** Hurwitz, M.M.; Wallace, D.R. (Naval Ship Research and Development Center, Bethesda, MD (USA). Computation, Mathematics and Logistics Dept.). May 1980. 27p. NTIS, PC A03/MF A01.

A numerical capability has been developed which will compute ohmic and viscous power losses in liquid metal current collectors. The present work extends previous analytical investigations in that semi-infinite collector geometries are no longer assumed. This new capability, is based on the finite element method and makes use of electrical current densities computed by the heat transfer portion of the NASTRAN structural analysis program. Although some limitations and questions remain, a comparison between the new numerical capability and experiment shows very good agreement in the computation of the power losses.

11375 **(AD-A—087125) Superconducting tunneling and tunneling applications in high Tc A15 superconductors. Final report.** Beasley, M.R. (Stanford Univ., CA (USA). Edward L. Ginzton Lab.). May 1980. 39p. NTIS, PC A03/MF A01.

This program was an outgrowth of our early empirical successes in forming superconducting tunnel junctions on thin films of the high transition temperature superconductors, specifically those in the so-called A15 class such as Nb_3Sn (T(c) approx. 18 K) and V_3Si (T(c) approx. 16 K). Prior to this all attempts at tunneling in the A15 superconductors had been on bulk material and were not widely successful. Moreover such non-thin film junctions are of limited device interest. As a result of this program we now have general junction formation techniques, apparently suitable for the A15 superconductors as a class, which are being routinely used for material diagnostics and for studies of the superconducting properties of these materials. More importantly, perhaps, they appear to have important device potential. We summarized only the main results and conclusions, referring the reader to the appendix for a more comprehensive discussion.

11376 **(AD-A—087448) Fabrication of Josephson tunnel junctions by reactive ion milling. Technical report.** Kleinsasser, A.W.; Buhrman, R.A. (Cornell Univ., Ithaca, NY (USA). School of Applied and Engineering Physics). 21 Jul 1980. 12p. NTIS, PC A02/MF A01.

A new technique has been developed for growing high quality, ultrathin oxide layers on metal films, suitable for use as tunneling barriers in Josephson junction devices. The oxides are produced with an argon-oxygen ion beam, and the rate of growth is determined by the competition between oxidation and sputtering by the ions. The oxidation technique has been applied to the fabrication of high current density submicron niobium-lead alloy Josephson junctions. High quality junctions have been produced with critical current densities exceeding 100,000 amp/sq cm and having low leakage currents at voltages below the energy gap. An edge geometry has been developed, allowing in-line junctions to be formed on the ion mill-patterned edge of Nb film. In this way, junction width is controlled by the Nb film thickness.

11377 **(BDX—613-2534) Training manual for precision hand deburring, Part 2.** Gillespie, L.K. (Bendix Corp., Kansas City, MO (USA)). Dec 1980. Contract AC04-76DP00613. 218p. NTIS, PC A10/MF A01.

Part 2 is presented of a 4-part training manual to be used by machinist trainees, production workers, and others removing burrs from precision miniature parts. The manuals are written to be self-teaching and are intended to be used with two hours of training each day along with another six hours of bench work in deburring.

11378 **(DOE/ER/01198—1340) Characterization of internal boundary layer capacitors based upon barium titanate and strontium titanate.** Park, H.D. (Illinois Univ., Urbana (USA). Dept. of Ceramic Engineering). 1981. Contract AC02-76ER01198. 108p. NTIS, PC A06/MF A01.

Thesis.

The nature of ceramic microstructure and the electrical properties of individual grains and junctions was determined by STEM, microprobe analysis and microscale electrical measurements. The chemical compositions of the resistive boundary re-

gions were different from those of the grains. Additives were concentrated in the boundary regions, forming resistive layers. Limited diffusion of the counterdopants into the grain subsurface formed an interfacial compensation layer between the insulating intergranular layer and the semiconducting grains. The electrical behavior of this intermediate layer was found to be similar to that of a depletion layer. Ceramic microstructures were approximated by a three-layer n-c-i-c-n model and representive equivalent circuit, which was used to explain the voltage dependence of the dielectric constant and dispersion behavior. Calculated properties were in good agreement with experimental values. Fine grain microstructures developed by liquid phase sintering techniques, were suitable for high dielectric constant multilayer capacitors, based upon internal boundary layer phenomena, and these capacitors had stable dielectric characteristics.

11379 **(DOE/R5/10221—1) Heat powered refrigeration compressor. Semi-annual technical report.** Goad, R.R. (Goad (Ronald R.), Evansville, IN (USA)). 1981. Contract FG02-80R510221. 103p. NTIS, PC A06/MF A01.

The objective of this program is to develop and improve the design of previously started prototypes of the Heat Powered Refrigeration Compressor. To build this prototype and ready it for testing by the University of Evansville is another goal. This prototype will be of similar capacity as the compressor that will eventually be commercially produced. This unit can operate on almost any moderate temperature water heat source. This heat source could include such applications as industrial waste heat, solar, wood burning stove, resistance electrical heat produced by a windmill, or even perhaps heat put out by the condenser of another refrigeration system. Work performed in the past four months has consisted of: engineering of HX-1; comparisons of specifications from different companies to ensure state of the art applications of parts for project; coordinating project requirements with machine shop; designing condenser; and partial assembly of HX-1.

11380 **(DOE/TIC—11389) Ceramic heat pipe development. Annual report, October 1, 1979-September 30, 1980.** Merrigan, M. (Los Alamos National Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 30p. NTIS, PC A03/MF A01.

Progress in developing ceramic heat pipe recuperators for recovering heat from industrial processing furnaces is reported. Information is included on the design, materials procurement, fabrication, materials testing, performance testing, performance and cost of ceramic heat pipes, especially tungsten-coated silicon carbide and SiC-W-Mo heat pipes.

11381 **(FNAL-TM—1012) Vacuum breaks of the doubler magnet system.** (Cryogenic Consultants, Inc., Allentown, PA (USA)). 31 Oct 1980. Contract AC02-76CH03000. 13p. NTIS, PC A02/MF A01.

The energy doubler system contains two vacuum systems; the cold beam tube vacuum and the insulating vacuum system. These two systems are independent of each other. Both have connections to the outside world through pumpouts. This report attempts to make an estimate of the effect of a massive failure (large rupture of a connection to the outside world) upon the magnets and the contained helium in the magnet system. It is assumed that the event takes place with magnets full of helium, at steady state cryogenic conditions, but without magnetic field. Quenching of the magnets is therefore not a part of this analysis.

11382 **(HEDL-TC—1880) Project CARDS technical information record: parametric and sensitivity analysis and determination of response spectra for horizontal, vertical and rotational motion of a radioactive material shipping package relative to the motion of its support (railcar). Part 2. Continuation of CARDS-TIR-80-3 (Preliminary).** Fields, S.R. (Hanford Engineering Development Lab., Richland, WA (USA)). 26 Nov 1980. Contract AC14-76FF02170. 203p. NTIS, PC A10/MF A01.

The generation of the response spectra was coupled to a parametric and sensitivity analysis. Support accelerations and tiedown forces are presented as functions of time. The parametric analysis found that the horizontal acceleration of the support and the MAR (max absolute relative) horizontal acceleration are relatively insensitive, while the corresponding vertical accelerations are highly sensitive to changes in 4 of the 13 parameters, and the corresponding rotational accelerations are highly sensitive to changes in 8 of the 13 parameters. The tiedown forces are moderately sensitive to changes in 3 of the parameters. (DLC)

11383 **(UCID—18824) Application of a large scale state estimator to the vibrational response of a mechanical structure.** Lager, D.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Sep 1980. Contract W-7405-ENG-48. 41p. NTIS, PC A03/MF A01.

The SEALS (State Estimator for Large Systems) computer code was applied to the estimation of displacement time histories of points on a vibrating mechanical structure given noisy measurements at two locations on the structure. The goal was to demonstrate the feasibility of determining the motion of internal members of the structure given only noisy measurements from the exterior and a finite-element model of the structure. This study was done in four distinct phases, i.e., model development; simulation of displacements vs time; acquisition of noisy measurement data (computer simulated); and estimation of displacements from measurements. The model was developed from the geometry of the structure using the ZONE finite-element mesh generator to produce an axi-symmetric finite-element model consisting of 15 elements and 32 nodes. The SAP4 code was used to translate the geometry and material properties into a 2nd order matrix differential equation (with matrices of size 87 by 87) which was then transformed into 174 state space equations (i.e., first order differential equations) for input to the SEALS state estimation code. A model check feature of SEALS was used to simulate displacement time histories at all the nodes of the finite-element model given an initial displacement for one of the nodes. Noisy measurements at two exterior locations on the structure were simulated by adding Gaussian white noise to the appropriate simulation waveforms. The standard deviation of the noise was chosen to given an approximate signal-to-noise ratio of 40. The SEALS code was used to reconstruct the displacement time histories of all the nodes of the model given the measurements, and erroneous initial value for both the initial condition displacement and the measurement noise covariance. Plots of displacement time histories at selected nodes of the model for simulation, measurement, and state estimation (reconstruction) are given.

11384 **(Y—2211) Digitally based pattern generator for an electron-beam welder.** Whitten, L.G. III. (Oak Ridge Y-12 Plant, TN (USA)). 19 Feb 1981. Contract W-7405-ENG-26. 62p. NTIS, PC A04/MF A01.

A digitally based deflection generator for an electron-beam welder is presented. Up to seven patterns of any shape are stored in programmable read-only memory (PROM). The pattern resolution is 39% at frequencies from 10 Hz to 1 kHz and can be x-t, y-t, or x-y formed. Frequency and pattern selections may be chosen by the welder computer or manually selected on the front panel. The ability to repeatedly synchronize two waveforms of any shape and frequency enables an unlimited variety of welds.

11385 **Multiphasic pump for rotating cryogenic machinery.** Eckels, P.W. (to Electric Power Research Institute). US Patent 4,223,239. 16 Sep 1980. Filed date 25 May 1978. vp.

A mixed phase pump for rapidly rotating cryogenic machinery is disclosed, preferably for installation to a superconducting generator rotor. The superconducting generator rotor includes an inner and outer rotor structure joined in a thermally insulated configuration not unlike that of a dewar flask. The inner rotor contains a support cylinder for a refrigerant, typically helium, which when refrigerated to 3.5° kelvin at one half a standard atmosphere under the normal rapid rotation of the axially aligned support cylinder, classifies itself into a two-phase liquid gas system. The phases include an outer cylindrical helium pool and an axially inward gaseous core separated by a cylindrical gasliquid interface. During normal operation of the rapidly revolving rotor, a pump removes the gas for recooling to a liquid state by receiving the gas in the vicinity of the axis of the rotor at an inlet. During abnormal operation including stator short-circuit and rapid rotational vibrational acceleration and deceleration of the rotor, the normal cylindrical

interface between the cylindrical helium pool and the vapor core is destroyed. The vapor core in the vicinity of the pump inlet becomes multiphasic and the pump inlet can induct/ingest quantities of liquid. Accordingly, a pump with the liquid gas classification volume located outwardly from the gas inlet to the pump is disclosed. This liquid trap volume in the pump assures that the outward passage of gas only from the pump occurs. Stability of the two-phase gas-liquid system as well as the prevention of thermal stressing of torque-transmitting members of the high speed rotating rotor is prevented.

11386 **Alkali metal protective garment and composite material.** Ballif, J.L.; Yuan, W.W. (to Dept. of Energy). US Patent 4,223,064. 16 Sep 1980. Filed date 10 May 1979. vp.
PAT-APPL-37,971.

A protective garment and composite material providing satisfactory heat resistance and physical protection for articles and personnel exposed to hot molten alkali metals, such as sodium are described. Physical protection is provided by a continuous layer of nickel foil. Heat resistance is provided by an underlying backing layer of thermal insulation. Overlying outer layers of fireproof woven ceramic fibers are used to protect the foil during storage and handling.

11387 **Trommel screen unit.** Burkes, D.O.; Valeri, W.J. (to Irathane Systems Inc). US Patent 4,222,865. 16 Sep 1980. Filed date 16 Feb 1979. vp.

The trommel screen unit includes a screen panel of polyurethane having embedded therein a plurality of longitudinal and transverse fiberglass rods. Marginal portions of the polyurethane panel overlie and are bonded to a rectangular steel frame, the sides of the frame having longitudinally spaced notches which receive therein the end portions of the transverse rod.

11388 **Superconductive magnetic shield and method of making same.** Opfer, J.E.; Pierce, J.M.; Valby, L.E. (to Develco Inc). US Patent 4,221,834. 9 Sep 1980. Filed date 17 Nov 1975. vp.

A relatively thin superconductive magnetic shield, as of lead, is supported from a hollow support structure, as of aluminum or fiberglass by means of a multiplicity of spots of adhesive, as of epoxy, serving to bond the superconducting shield to the support structure. The shield and support structure is then positioned within a reentrant cryostat and cooled to liquid helium temperature to render the shield superconductive. Adjacent edges of the shield material are outwardly flanged and sealed together at the flanged portions, as by welding. The spot pattern of adhesive permits the shield to flex during thermal cycling to relieve strain and prevent fracture thereof while at the same time supporting the shield in a substantially nonmicrophonic manner.

11389 **Linear motor drive system for continuous-path closed-loop position control of an object.** Barkman, W.E. (to Dept. of Energy). US Patent 4,221,995. 9 Sep 1980. Filed date 24 Jul 1978. vp.
PAT-APPL-927,442.

A precision numerical controlled servo-positioning system is provided for continuous closed-loop position control of a machine slide or platform driven by a linear-induction motor. The system utilizes filtered velocity feedback to provide system stability required to operate with a system gain of 100 inches/minute/0.001 inch of following error. The filtered velocity feedback signal is derived from the position output signals of a laser interferometer utilized to monitor the movement of the slide. Air -bearing slides mounted to a stable support are utilized to minimize friction and small irregularities in the slideway which would tend to introduce positioning errors. A microprocessor is programmed to read command and feedback information and converts this information into the system following error signal. This error signal is summed with the negative filtered velocity feedback signal at the input of a servo amplifier whose output serves as the drive power signal to the linear motor position control coil.

11390 **Insulated conduit.** Reale, S. (to Sunergy Corp). US Patent 4,221,239. 9 Sep 1980. Filed date 23 Apr 1979. vp.

An insulated conduit is described that is composed of an inner structural tubing with each length or bend of said tubing having a bell socket at one end with a matching spigot joint at the other end, and so arranged that one is enabled to assemble comparatively long continuous lengths of the insulated conduit. Resting blocks are placed at appropriate position and distances within the inner structural tubing whereby energy carrying piping may be inserted within the inner structural tubing and rest upon said blocks. The energy carrying piping is protected from loss of heat energy by the insulative value of the ambient air within the inner structural tubing and also by the inclusion of inert air spaces located between a series of structural ribs which form a support between the inner structural tubing and an outer insulation jacket. The outer insulation jacket having annular tongue and groove matching configurations at the ends combined with a system of wire anchors which are incorporated for making easily formed joints being moisture resistant and thus protecting the inner energy carrying piping from corrosion and heat loss. The use of a binding material such as wire is employed to hold continuous lengths of the insulated conduit together during installation.

11391 **Cryosolenoid valve.** Pauliukonis, R.S. US Patent 4,220,312. 2 Sep 1980. Filed date 12 Dec 1977. vp.

An internally piloted shut-off valve is described for use with cryogenic fluids incorporates a short valve housing with normally closed valve closure means incorporated therein and fluid passages with ports for fluid flow therethrough including an elongated extended stem protruding therefrom on top of which a solenoid operator is received in the stem end opening so as to define a cavity therein housing a large piston interconnected with the valve closure means by an internally piloted concentric tubing disposed coaxially with the stem and, in combination with large piston, comprising valve actuating means which permit the use of conventional solenoid operator and a trickle of cryogenic fluid converted to vapor inside pilot passage of the tubing and supplied to the cavity at atmospheric temperature when solenoid is enerized, creating pressure differential therein capable of maintaining valve open until the solenoid operator is deenergized, allowing valve closing automatically.

11392 **Josephson tunnel junction with polycrystalline silicon, germanium or silicon-germanium alloy tunneling barrier.** Kroger, H. (to Sperry Corp). US Patent 4,220,959. 2 Sep 1980. Filed date 23 Mar 1979. vp.

A Josephson tunnel junction device having niobium nitride superconductive electrodes includes a polycrystalline semiconductor tunnelling barrier therebetween comprised of silicon, germanium or an alloy thereof preferably deposited on the lower superconductive electrodes by chemical vapor deposition. The barrier height of the junction is precisely controlled by precision doping of the semiconductor material.

11393 **Method and apparatus for self orienting a drill string while drilling a well bore.** Hamilton, J.E. US Patent 4,220,213. 2 Sep 1980. Filed date 7 Dec 1978. vp.

The low side of a well bore drilled by a rotary drill string with a drill bit thereon is instrumentally determined as to direction and inclination. An eccentric tubular member is rotatably supported on the drill string and is provided with projection means extending beyond the drill bit diameter and lowered into the well bore. The eccentric tubular member rotates so that the heavy side thereof rests on the low side of the well bore and positions the projection thereon in a predetermined circumferentially spaced and angular relationship relative to the low side of the well bore so that the projection engages the well bore wall during drilling operations and urges the bit laterally of the well bore. During drilling operations, the projection means assumes authority over the drill bit since it extends beyond the diameter of the drilling bit and thus positions the drilling bit laterally in the well bore in a predetermined manner as the drill string is rotated to drill the well bore. The self orienting directional drilling control arrangement includes the eccentric member, support means to support the member in the drill string for relative rotation therebetween and the projection means on the eccentric member which is circumferentially spaced relative to the heavy side thereof and extends radially beyond the drill bit diameter which is secured in the drill string.

11394 **Directional drilling sub.** Benoit, L.F. US Patent 4,220,214. 2 Sep 1980. Filed date 18 Aug 1977. vp.

A directional drilling "sub" provides a shifting end portion which allows the sub to be rotated from a first in-line axially straight orientation with the drill string to a second angled or "bent" position which second position is normally associated with conventional bent "subs" which are permanently structured in the bent position. The device shifts from the first (In-line) position to the second (Bent) position upon the application of torsional force thereto which torsional force can be applied, for example, by the actuation of a "turbodrill" (Normally attached thereto in operation). The device can be manufactured or machined to provide varying angles to the sub in its bent position to satisfy differing directional drilling situations. The axially aligned first position allows easy entry of the drill string, sub , and turbodrill into the well hole, while the second bend position is used to commence directional drilling. The sub will return gradually to its original axially aligned position when the device is withdrawn from the wellhole, as such position is the path of minimum resistance for the withdrawing drill string and torsion is not present to hold the sub in the bent position.

11395 **Drill pipe telemetering system with electrodes exposed to mud.** (to Shell Oil Co). US Patent 4,220,381. 2 Sep 1980. vp.

A drill string telemetry system of the hard-wired type is described wherein a separate conductor extends through each section of the drill pipe. The conductor is connected to connectors located in the ends of the drill pipe with the connectors completing the electrical circuit as the drill pipe is assembled. The connectors are designed to be exposed to the drilling fluid and include an amplifier.

11396 **Dry-out phenomena in gravity-assist heat pipes with capillary flow.** Busse, C.A. (Commission of the European Communities, Ispra (Italy). Joint Research Centre); Kemme, J.E. (Los Alamos Scientific Lab., NM (USA)). *International Journal of Heat and Mass Transfer ;* **23**: No. 5, 643-654(May 1980).

The physical mechanism of the dry-out in gravity-assist heat-pipes with capillary flow is analysed. Two contrary types of dry-out are shown to exist. The axial 'dry-out' arises from a lack of hydrostatic driving force and appears when the heat flux increases. For the 'azimuthal dry-out' it is just the opposite. The basic relations for the occurrence of these dry-outs are derived. Their evaluation is explained in an example. Methods for preventing the azimuthal dry-out are discussed. An Appendix contains some critical comments on the role of inertia forces and entrainment in heat pipes.

11397 **(ORNL-tr—4704) Transient testing technique for heat exchanger fin.** Yoshii, T. Translated from *Reito ;* **47**: No. 531, 23-29(1972). 16p. NTIS, PC A02/MF A01.

The heat transfer characteristics of heat exchanger fin surfaces were determined by several methods. The transient testing technique is described with a summary of the underlying theory, an experimental facility is described and some data on a few fin surfaces obtained by this technique are presented.

4203 Lasers

11398 **(AD-A—086159) DARPA-NRL laser program annual technical report to Defense Advanced Research Projects Agency. Annual report 1 Oct 78-30 Sep 79.** Champagne, L. (Naval Research Lab., Washington, DC (USA)). 30 Apr 1980. 157p. NTIS, PC A08/MF A01.

The DARPA-NRL program is concerned with the development of laser technology. The basic physics of the XeCl laser have been examined theoretically and experimentally. The basic physics behind the improved performance of the XeF laser at elevated temperature is reported. The limitations of the Kr2F* laser have been studied. Preliminary experiments involving two other promising visible lasers (HgBr, XeF(C to A transition)) are reported.

11399 **(AD-A—086495) Optically pumped far infrared molecular lasers. Final report 1 Feb 76-31 Jan 80.** Coleman, P.D. (Illinois Univ., Urbana (USA). Electro-Physics Lab.). Apr 1980. 138p. NTIS, PC A07/MF A01.

This report summarizes studies on optically pumped far infrared molecular gas lasers. The research has been concerned with the general subjects of far infrared integrated optics and technology, the discovery of new optically pumped molecular laser systems, and the study and analysis of nonlinear processes (Raman and hyper-Raman) that can occur in optically pumped systems. The theoretical density matrix analysis of the gain spectra of nonlinear systems and the first detailed experimental measurements of these systems are presented. It is demonstrated that third and fifth order nonlinear processes can exceed first order laser processes. An experimental study of the generation of a 22.653 GHz signal (the largest wavelength yet reported) in optically pumped NH_3 is described. The frequency tunability and single shot spectral characteristics of the signal were measured with precision. A single laser pump in a four-level system can yield two laser signals, which in the linear case are not coupled together. However, with stronger pumping, nonlinear effects can couple the two laser signals with the result that the behavior of one laser signal is determined by the other and vice versa. The self-consistent analysis of this problem is described.

11400 **(AD-A—086552) Bibliography of Soviet laser developments. Number 42, July-August 1979.** (Defense Intelligence Agency, Washington, DC (USA)). May 1980. 113p. NTIS, PC A06/MF A01.

This is the Soviet Laser Bibliography for July-August 1979 and is no. 42 in a continuing series on Soviet laser developments. The coverage includes basic research on solid state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; and general laser theory. Laser applications are listed under biological effects; communications; beam propagation; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

11401 **(AD-A—086553) Bibliography of Soviet laser developments. Number 43, September-October 1979.** (Defense Intelligence Agency, Washington, DC (USA)). Jun 1980. 140p. NTIS, PC A07/MF A01.

This is the Soviet Laser Bibliography for September-October 1979 and is no. 43 in a continuing series on Soviet laser developments. The coverage includes basic research on solid state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications; beam propagation; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

11402 **(AD-A—086657) Calculation of the energetics and collision dynamics of electronic transition lasers. Final report 1 Apr 77-31 Mar 80.** Michels, H.H.; Hobbs, R.H. (United Technologies Research Center, East Hartford, CT (USA)). May 1980. 55p. NTIS, PC A04/MF A01.

This research develops techniques and computational schemes for a priori prediction of the kinetics and the product distribution of atomdiatom reactions. This involves (1) improved calculation techniques for potential energy surfaces for the reactants and products; (2) quantum and classical mechanical calculations of the dynamics of the reaction; and (3) detailed calculations for systems with high potential as electronic transition lasers.

11403 **(AD-A—086670) Development of x-ray laser media: measurement of gain and development of cavity resonators for wavelengths near 130 angstroms. Annual report 1 Nov 78-31 Dec 79.** Forsyth, J.M. (Rochester Univ., NY (USA). Lab. for Laser Energetics). Feb 1980. 34p. NTIS, PC A03/MF A01.

A new experimental facility was used to explore a range of conditions under which inverted populations on soft x-ray transi-

tions could be produced in laser heated plasmas. Direct measurements with grating spectrographs were performed in the vicinity of 130 angstroms to develop the diagnostic techniques for gain determination. Designs for reflectors suitable for use in cavity resonators at soft x-ray wavelengths were developed. Construction of apparatus to produce such reflectors was begun. A patent on the reflector design was applied for.

11404 **(AD-A—086688) High power submillimeter and infrared radiation from intense relativistic electron beams. Final Repot 1 Jan 75-31 Dec 79.** Schlesinger, S.P.; Marshall, T.C.; Diament, P. (Columbia Univ., New York (USA). Dept. of Electrical Engineering and Computer Science). Mar 1980. 11p. NTIS, PC A02/MF A01.

A series of experiments was performed to test the dependence of superadient power generated by stimulated Raman backscattering (at 2 mm wavelength) upon ripple-field amplitude and length. Experiments were also performed to understand the possibility of using distributed feedback in a collective mode free electron laser. A theoretical study was completed to understand the growth of circular waveguide modes by parametric coupling to cold beam waves, with field gradients included. This is similar to free electron laser configurations to be studied in upcoming experiments.

11405 **(AD-A—086698) Cross sections for ionization of rare gas excimers by electron impact and atomic and molecular processes in excimer lasers. Final report 1 Apr 78-30 Sep 79.** Flannery, M.R.; McCann, K.J. (Georgia Inst. of Tech., Atlanta (USA). School of Physics). Mar 1980. 121p. NTIS, PC AF A01.

Theoretical cross sections for ionization of metastable excimers - helium, neon, argon, krypton and xenon - and of metastable mercury are presented. Systematic trends in inelastic form factors and Born cross sections for collisional transitions between excited neighboring levels of atoms are discovered and discussed. Key cycles of atomic and molecular collision processes in excimer lasers are delineated and discussed.

11406 **(AD-A—086764) Atomic and molecular processes. Final report 1 Jul 75-15 May 80.** Biondi, M.A. (Pittsburgh Univ., PA (USA)). 25 Jun 1980. 6p. NTIS, PC A02/MF A01.

The topics investigated experimentally and theoretically by the Pittsburgh Atomic Sciences Institute with applications to high power laser development and atmospheric IR backgrounds are enumerated. Reports containing the detailed scientific progress in these studies are cited. Finally, a list of the journal articles describing the results of the programs, with full references, is given.

11407 **(AD-A—086776) Slow wave cyclotron instability in dielectric loaded waveguide of rectangular cross-section. Final report.** Ganguly, A.K.; Chu, K.R. (Naval Research Lab., Washington, DC (USA)). 18 May 1980. 21p. NTIS, PC A02/MF A01.

Slow wave cyclotron instability in dielectric loaded waveguides driven by an anisotropic velocity distribution is considered. The spatial growth rate of the radiation field is calculated by deriving a dispersion relation of the waveguide modes in the presence of a weak electron beam. It is shown that broad band amplification is possible in such structures. Bandwidth in excess of 60% is obtained for a 'cold' beam. The bandwidth decreases with increase in the velocity spread of the electrons. At 5% velocity spread, the bandwidth decreases to 12%. The dependence of the gain and bandwidth on other material and electron beam parameters as well as the applied magnetic field is discussed.

11408 **(AD-A—086829) Energy transfer and optical spectroscopy of diatomic molecules in chemically reacting systems. Final report 1 Aug 76-31 Dec 79.** Broida, H.P.; Harris, D.O. (California Univ., Santa Barbara (USA)). Dec 1979. 8p. NTIS, PC A02/MF A01.

Increased capabilities in remote sensing, communication and several other areas depend on developments in laser technology. Chemical lasers indicate a high probability of fulfilling these needs through their properties of different wavelengths, high power, high operating efficiency and lower weight. Additionally, optically pumped metal dimers are attractive systems for visible, tunable gas lasers. The development of new improved chemical laser systems and optically pumped laser systems requires an increased understanding and knowledge of the properties and characteristics of candidate reactions and molecules. Detailed spectroscopic studies on both CuF and Ca2 have been carried out. Use of laser photoluminescence has produced spectroscopic information previously unobtainable. We have obtained improved molecular constants and dissociation energies, radiative lifetimes, and quenching cross-sections for electronically excited products. In addition previously unknown electronic states have been identified.

11409 **(AD-A—086856) Short pulse uv-visible waveguide laser. Final technical report 15 May 79-14 May 80.** Newman, L.A. (United Technologies Research Center, East Hartford, CT (USA)). 1 Jul 1980. 72p. NTIS, PC A04/MF A01.

The operation of a $N_2(+)$ ion waveguide laser (4278 A) excited by charge transfer from $He_2(+)$ created in a capacitively coupled self-sustained discharge is described. In addition, the results of an experimental diagnostic program and a computer modeling program, conducted to explain the general operations of the discharge pumped He-N_2 system, are presented. The results of this program indicate upper laser level electron quenching and lower level pumping may be seriously limiting the achievable laser efficiency of this system.

11410 **(AD-A—087056) Resonant interaction between an active molecular medium and a free electron laser. Technical report.** Wilhelmsson, H. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Dec 1979. 19p. NTIS, PC A02/MF A01.

The system of a relativistic electron beam and an active molecular (maser) medium in the presence of a ripple magnetic field is studied theoretically. The tunability of the free electron laser could be used to reach different lines of such a molecular medium. We use a Lorentz model to describe the molecular transitions, a hydromagnetic model for the beam, and formulate the resonance condition for the two cases where (1) the coupling occurs at a common interface, e.g., cylindrical, between the beam and the molecular medium, and (2) the beam and the molecules fill the same volume in space. The coupling between the beam and the molecules offers possibilities of enhanced radiation and improved coherence. In the case where the free electron laser acts as a pump of the molecules stimulated radiation could in principle be obtained at a new wavelength, i.e., the coupled system acts as a frequency transformer.

11411 **(AD-A—087123) Optical and discharge studies of novel electronic transition laser species. Technical report.** Leone, S.R. (Joint Inst. for Lab. Astrophysics, Boulder, CO (USA)). 4 Jan 1980. 18p. NTIS, PC A02/MF A01.

A new class of diatomic lasers has been developed by optical pumping. These lase on lines in the near ultraviolet and visible regions of the spectrum. Optical excitation studies show that these molecular systems have high efficiency, may be scalable to high average powers, are nondegradable, and offer promise for pumping by other excitation schemes, such as electric discharge. It is possible that one or more candidate systems in this category of lasers might be useful in generating blue-green radiation for underwater applications. Preliminary investigations with electric discharge excitation show good formation of glow dischargers in sulfur dimer vapor. Materials problems and the difficulties of high temperature discharge technology appear to be the major drawbacks in pursuing such studies further for laser action.

11412 **(AD-A—087207) Unsteady thermal blooming of intense laser beams. Final report 1975-1977.** Ulrich, J.T.; Ulrich, P.B. (Naval Research Lab., Washington, DC (USA)). 31 Jan 1980. 19p. NTIS, PC A02/MF A01.

A four-dimensional (three space plus time) computer program has been written to compute the nonlinear heating of a gas by an intense laser beam. Unsteady, transient cases are capable of solution and no assumption of a steady state need be made. The transient results are shown to asymptotically approach the steady-state results calculated by the standard three-dimensional thermal blooming computer codes. The report discusses the physics of the laser-

absorber interaction, the numerical approximation used, and comparisons with experimental data. A flowchart is supplied in the appendix to the report.

11413 **(AD-A—087219) Mid-term progress report on the development of army Closed Cycle Circulator (CCC) system. Technical report.** Cole, M.W.; Shih, C.C. (Army Missile Command, Redstone Arsenal, AL (USA). High Energy Laser Center). 20 Sep 1979. 111p. NTIS, PC A06/MF A01.

A Closed Cycle Circulator System was developed for recirculating the laser gas through the cavity in order that problems of acoustic attenuation, thermal control, gas contamination, and power gain may be investigated for various pulsed energy inputs at the cavity. The circulator was assembled and tested for its performance evaluation. Its instrumentation subsystem was developed and calibrated to a reasonable accuracy. For safety, standard operating procedures have been established for review and approval. The instruments calibrated include hot wire anemometers for velocity and temperature, piezoelectric transducers for pressure, flow meter for mass flow rate, and interferometer for medium homogeneity. A series of trial tests of the Closed Cycle Circulator System resulted in an experimental analysis of performance data providing a better control of flow conditions in the cavity through the control mechanism.

11414 **(AD-A—087245) Laser physics and laser techniques. Final technical report, 1 Jan 77-31 Dec 79.** Siegman, A.E.; Byer, R.L. (Stanford Univ., CA (USA). Edward L. Ginzton Lab.). Feb 1980. 98p. NTIS, PC A05/MF A01.

A three-yrea program research in laser physics and techniques has been carried out to help meet Air Force mid- and long-term requirements. Development of an optically pumped atomic mercury laser was completed. Picosecond spectroscopy experiment led to measurements of ultrafast relaxation and diffusion times in solids. Work on efficient numerical methods for optical resonator calculations resulted in a Fast Hankel Transform for calculations in cylindrical coordinates. Improvements to the FHT algorithm have been made and a two-stage algorithm developed. An efficient procedure for analyzing nonlinear beam interactions has been developed; also several fundamental questions on aspects of laser resonators have been resolved. A diffraction-biased ring resonator was invented, and an analysis of phase conjugate mirror resonators carried out. Studies of optically pumped lasers including mercury dimer as a potential laser mechanism were carried out. A number of two photon laser systems were investigated, and studies of four-wave mixing as a frequency conversion process completed. Improvements in the growth of lithium niobate crystals led to higher power tunable infrared and visible sources. Finally, stimulated rotational Raman scattering was demonstrated for efficient frequency conversion in the infrared.

11415 **(AD-A—087248) Sensitive measurement of photon lifetime and true reflectances in an optical cavity by a phase shift method. Technical report.** Herbelin, J.M.; McKay, J.A.; Kwok, M.A.; Ueunten, R.H.; Urevig, D.S. (Aerospace Corp., El Segundo, CA (USA). Aerophysics Lab.). 10 Jul 1980. 23p. NTIS, PC A02/MF A01.

A simplified method for measuring the effective photon lifetime in an optical resonator was developed. The technique requires the passage of a modulated continuous-wave laser beam through the resonator and the measurement of the resultant shift in the phase of the transmitted intensity. The method not only permits a quick and precise measurement of the mirror reflectances, but also permits these measurements to be in situ. Such an 'on the spot' evaluation capability should be extremely useful in applications ranging from the investigation of new laser systems to the development of improved optical coatings. The method is also sensitive to the effects of absorption, scattering, and transmission from elements in the cavity. Cavity losses smaller than 100 ppm were detected.

11416 **(AD-A—087421) Short intense submillimeter pulse generation. Final report 1 Jul 79-30 Jun 80.** DeTemple, T.A. (Illinois Univ., Urbana (USA). Electro-Physics Lab.). Jul 1980. 27p. NTIS, PC A03/MF A01.

The use of a mode-locked CO_2 laser for an optically pumped near millimeter wave source has been refined and extended to the generation of pulses form C(13)H3F at 1.22mm. More refined theoretical estimates illustrate the transient nature of the conversion process in both space and time and set approximate limits on the ultimate pulse duration to be about one-half that of the pump. The implications are that one is not limited by the intrinsic linewidth in producing short pulse and that significant conversion may occur in modest distances, in the order meters, suggesting quasi-compact sources for further experiments.

11417 **(LA-UR—81-145) Ultraviolet phase conjugation and its practical implications.** Feldman, B.J.; Fisher, R.A.; Shapiro, S.L. (Los Alamos National Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-801201—8). NTIS, PC A02/MF A01.

From 3. international conference on lasers and applications; New Orleans, LA, USA (15 Dec 1980).

The first demonstration of uv phase conjugation is reported. Using a 15 psec, 2660 A pulse, 0.1% conjugate reflectivities were obtained via degenerate four-wave mixing in 1-mm samples of CS_2 mixtures. While pure CS_2 did not exhibit the effect, dilution in several uv transmitting solvents opened up a concentration-tunable (2450 A to 2850 A) spectral window, allowing the optical Kerr effect to be utilized. Weaker phase conjugation at 2660 A was also observed in other Kerr media and in saturable absorber media.

11418 **(LA-UR—81-150) Can optical phase conjugators produce a very short conjugate pulse.** Suydam, B.R. (Los Alamos National Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-801201—9). NTIS, PC A02/MF A01.

From 3. international conference on lasers and applications; New Orleans, LA, USA (15 Dec 1980).

In studying the transient behavior of phase conjugation via four wave mixing, it has been noted that very short probe pulses invariably produce considerably broadened conjugate pulses unless the conjugator is inordinately short. The present investigation was therefore undertaken to determine whether a short conjugate pulse might be produced by judicious programming of the probe. It was found that the probe can indeed be tailored to produce an arbitrarily short conjugate signal and, if the conjugating medium exhibits linear absorption, then the total energy in the probe signal is finite. The required probe programming can be determined by numerical evaluation of a Fourier transform.

11419 **(PB—80-191141) Measuring features of the fluence at the far field of a CO_2 pulsed laser: an issue study with suggestions on how to do it.** Johnson, E.G. Jr.; Phelan, R.J. Jr.; Boyle, D.R. (National Engineering Lab. (NBS), Boulder, CO (USA)). Apr 1980. 56p. NTIS, PC A04/MF A01.

This study examines the problems for measuring the energy density incident on targets where the energy is from a pulse of high energy at CO2 wavelengths and where the targets are located at the far field. The analysis considers two targets--first, a ground-based target for testing and calibration of the measurement systems and second, a drone towed behind an airplane from which the energy distribution information is telemetered to the ground station. Although certain design limits are assumed, the results are general and therefore specific data about the laser sources is not supplied. This study traces each stage of the measurement system from the reception of the incident laser pulse on the drone to the pulse-coded transmission of the sampled data to a ground-based computer.

11420 **(PB—80-811573) Infrared upconversion. 1964-May, 1980 (a bibliography with abstracts). Report for 1964-May 80.** Carrigan, B. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 130p. NTIS PC N01/MF N01.

Studies on device performance, materials, theory, and applications are cited. Tunable lasers, infrared detection, crystal modulators, and frequency converters are included. (This updated bibliography contains 122 abstracts, 4 of which are new entries to the previous edition.)

11421 **(PB—80-812209) Light emitting diodes. June, 1976-May, 1980 (a bibliography with abstracts). Report for Jun 76-May 80.** Carrigan, B. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 241p. NTIS PC N01/MF N01.

Studies on electroluminescent and semiconductor lasers are presented in the bibliography. Theory, design, applications, and materials are covered with applications including displays, optical communications, laser illuminators, signal processing, and avionics. (This updated bibliography contains 230 abstracts, 45 of which are new entries to the previous edition.)

11422 **(SAND—81-0218C) HF chemical lasers ignited by CO_2-laser irradiation.** Cummings, J.C. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 7p. (CONF-801201—10). NTIS, PC A02/MF A01.

From 3. international conference on lasers and applications; New Orleans, LA, USA (15 Dec 1980).

A pulsed CO_2 laser was used to ignite mixtures of SF_6:H_2 and S_2F_{10}:H_2. The chemical reactions initiated by the CO_2 laser produce vibrationally-excited HF which were observed to lase when an optical resonator was constructed around the reaction cell. The HF-lasing performance of these gas mixtures as a function of mixture ratio, pressure, and several CO_2-laser parameters (frequency, fuence, and pulse duration) are compared. Under comparable conditions, the HF-laser output for S_2F_{10}:H_2 mixtures was ~ 6 times greater than that for SF_6:H_2 mixtures. Two results were observed that are not fully understood at present: First, the HF-laser output for S_2F_{10}:H_2 mixtures increased linearly with CO_2-laser fluence, reached a maximum value, and then decreased - this decrease may be due to excessive heating of the gases. Second, variations in CO_2-laser frequency indicated that the frequency for maximum HF-laser energy from S_2F_{10}:H_2 mixtures was blue-shifted with respect to the peak absorption frequency for S_2F_{10} - this may be due to significant SF_6 absorption of the CO_2-laser radiation.

11423 **(UCRL—15310) Growth of high phasematched temperature $LiNbO_3$ single crystals and application to efficient second harmonic generation of Nd:YAG. Final report.** Byer, R.L.; Park, Y.K.; Feigelson, R.S.; Kway, W.L. (Stanford Univ., CA (USA). Center for Materials Research). Aug 1980. Contract W-7405-ENG-48. 36p. NTIS, PC A03/MF A01.

It was demonstrated that $LiNbO_3$ crystals with a phasematching temperature greater than 180°C can be grown with small concentration gradients from a melt doped with MgO and excess Li_2O together with a planar growth interface; that the phasematch temperature can be readily adjusted simply by changing the excess Li_2O concentration proportional to the phasematch temperature desired; that the crystal quality and SHG characteristics can be maintained as long as the MgO concentration and growth parameters are held constant. We have also found that the self-annealing temperature is much lower, near 120°C for the Stanford grown crystals, as compared to the previously reported value of 170 to 180°C. Taking advantage of the lower self-annealing temperature, the crystals grown with phasematching temperature of approximately 120°C showed exceptional optical homogeneity, and a 40% average power SHG conversion efficiency. The improved hot phasematching $LiNbO_3$ crystals along with the electro-optical or piezo-optical compensation for self heating effects should greatly enhance crystal device applications to high average power second harmonic generation of the Nd:YAG source.

11424 **Offshore construction.** Brinkmann, F.J.; Kuffel, W.; Schaloske, P. (to Deutsche Babcock Ag (Germany)). US Patent 4,222,683. 16 Sep 1980. Filed date 23 Aug 1978. vp.

An offshore construction arrangement in which a platform is provided with raisable and lowerable support legs which engage a substructure resting on the sea bed. The parts lie on one another in a solid support surface and engage over one another while maintaining a funnel-shaped gap. Spring elements are located between side walls of the substructure and end portions of the legs, and the spring elements are supported on one of the side walls. The spring elements are displaceable in horizontal and vertical directions, and they are constructed as leaf springs arranged in a funnel. The leaf springs protrude beyond the rim of the funnel and are pre-bent inwardly. The leaf springs, furthermore, may be supported by lateral springs, and an auxiliary funnel may be used to receive the spring elements while being exchangeably arranged in the first-mentioned funnel. The spring elements may be in the form of several blocks of elastic material and spaced from each other. The blocks may also be provided with a slide rail on their side facing the interior of the first-mentioned funnel.

11425 **High energy, rapid discharge device for the excitation of gas discharge lasers.** Colson, S.D.; Engelking, P.C.; Turner, R.E. US Patent 4,223,278. 16 Sep 1980. Filed date 31 Jan 1977. vp.

A new method and apparatus is described for storing and delivering the electrical energy used to drive high powered, gas discharge laser devices which require transverse electrical excitation utilizes high voltage commercial storage capacitors and the optimum electrical characteristics and cost advantages of planar electrical transmission lines.

11426 **Pulsed electric discharge laser utilizing water dielectric blumlein transmission line.** Bradford, R.S.; Braverman, L.W.; Levatter, J.I. (to Mathematical Sciences Northwest Inc). US Patent 4,223,279. 16 Sep 1980. Filed date 18 Jul 1977. vp.

A pulsed electric discharge gas laser driven by a folded blumlein transmission line with liquid dielectric is described. A method of preionizing and firing the laser discharge utilizing the blumlein voltage pre-pulse for preionization and the subsequent main voltage pulse for gap switch breakdown. A spark gap switch construction with first and second elongate electrodes, with the first electrode presenting a generally rounded surface to the second electrode which incorporates a thin continuous edge facing the first electrode. An elongate apertured cathode at the lasing chamber, with an elongate preionization electrode positioned behind the cathode, and a power supply providing a preionization electrical pulse across the cathode and preionization electrode producing ions and electrons in the lasing gas prior to the main discharge between the anode and cathode.

11427 **Stokes injected raman capillary waveguide amplifier.** Kurnit, N.A. (to Dept. of Energy). US Patent 4,222,011. 9 Sep 1980. Filed date 3 Oct 1978. vp.

PAT-APPL 948,267.

A device is described for producing stimulated Raman scattering of CO_2 laser radiation by rotational states in a diatomic molecular gas utilizing a stokes injection signal. The system utilizes a cryogenically cooled waveguide for extending focal interaction length. The waveguide, in conjunction with the stokes injection signal, reduces required power density of the CO_2 radiation below the breakdown threshold for the diatomic molecular gas. A fresnel rhomb is employed to circularly polarize the stokes injection signal and CO_2 laser radiation in opposite circular directions. The device can be employed either as a regenerative oscillator utilizing optical cavity mirrors or as a single pass amplifier. Additionally, a plurality of Raman gain cells can be staged to increase output power magnitude. Also, in the regenerative oscillator embodiment, the Raman gain cell cavity length and CO_2 cavity length can be matched to provide synchronism between mode locked CO_2 pulses and pulses produced within the Raman gain.

11428 **Baffle/nozzle array for cylindrical laser.** Kuhn, R.F. (to U S Of America Air Force Secretary). US Patent 4,220,933. 2 Sep 1980. Filed date 20 Jul 1978. vp.

A nozzle/baffle array for use within the gain generator of a cylindrical laser is described. The nozzle/baffle array is made of a nozzle assembly and a plurality of baffles. The baffles extend in the radial direction from the centerbody of the cylindrical laser supporting the nozzle assembly circumferentially about the centerbody. As a consequence of the novel arrangement and design of the baffles, the baffles provide a spring support for the nozzle assembly while simultaneously supporting the nozzle assembly in great alignment accuracy permitting adequate thermal growth to take place between the nozzle assembly and the centerbody of the laser.

11429 (LA-UR—81-15) Pulse propagation in a one-atmosphere CO_2 laser amplifier. Czuchlewski, S.J. (Los Alamos Scientific Lab., NM (USA)). [nd]. Contract W-7405-ENG-36. 19p. (CONF-801201—7). NTIS, PC A02/MF A01.

From 3. international conference on lasers and applications; New Orleans, LA, USA (15 Dec 1980).

The theoretical propagation of short (150-ps) laser pulses in a one-atmosphere CO_2 amplifier is investigated using a fully coherent density-matrix computer code. The influence of coherent effects and of the response times of the amplifying medium on the temporal shape of the output pulse is examined. It is found that short pulses, whose width is approximately equal to the T_2 time of the medium, can be effectively amplified.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 10113, 10911, 10950, 10951, 11396, 11397

11430 (AD-A—086659) Analysis of numerical methods for the equations of fluid dynamics. Final report. Hall, C.A.; Porsching, T.A. (Pittsburgh Univ., PA (USA). Dept. of Mathematics and Statistics). Jun 1980. 6p. NTIS, PC A02/MF A01.

During the last twenty-five years, the published literature on computational fluid dynamics has grown enormously. However, there are few papers dealing with the analysis of computational methods for time dependent multidimensional flow. There also seems to be a polarization of investigators into two groups: advocates of finite difference methods and advocates of finite element methods. It is our contention that an 'ideal' computational model for fluid flow problems may in fact draw on the strengths of both schools of thought. For example, we have recently implemented a frontal solution technique, originally devised for finite element analyses, in a finite difference model of two-phase fluid flow.

11431 (AD-A—086795) Two-phase nozzle theory and parametric analysis. Annual technical report 15 May 79-14 May 80. Kuo, S.C.; Deane, C.W. (United Technologies Research Center, East Hartford, CT (USA)). Jun 1980. 94p. NTIS, PC A05/MF A01.

This study sought to formulate a working theory with which the performance of two-phase nozzles can be analyzed parametrically over a wide range of flow conditions and fluid properties. As a basis for formulating the theory, the technical status of two-phase nozzles was assessed, the governing flow parameters were identified, and the flow domains classified with the previously available theory. A working theory of two-phase nozzles suitable for parametric analyzes and optimization was then formulated, incorporating the significant interphase effects of velocity slip, droplet breakup, and droplet heat transfer. Liquid/gas combinations for two-phase nozzles, and suitable combinations for marine propulsion and other selected applications were discussed. Single-phase (or homogeneous) theory was reviewed from the viewpoints of energy conversion in a nozzle and was compared with models applicable to separate phases in terms of their flow domains. Finally, a working theory of two-phase nozzles was formulated based on the governing flow parameters and on six basic equations that described the two-phase flow. From this theory, a computer model was developed which includes the significant interphase effects of velocity slip, droplet beakup, and heat transfer and which is suitable for parametric analysis and optimization. Preliminary parametric calculations based on use of this model were compared with results from previous two-phase nozzle models and with available experimental data.

11432 (DOE/ET/10527—T1, pp 217-236) Heat transfer to gas-solid suspensions in vertical cocurrent downflow. Sep 1980.

In Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Final report.

Friction factors and Nusselt numbers obtained from the test runs with air alone show good agreement with correlations for single-phase flow, e.g., Nikuradse equation for the friction factor and Kays equation for the Nusselt number. Axial pressure drop profiles reveal that the hydraulic entry length is considerably extended, up to an L/D of 300, by the addition of particles, and that it is dependent only on particle flow rates. At low gas flow rates, negative total pressure drops were observed; however, the frictional pressure drop calculated always became positive and then increased with solids-loading ratio. Comparison of the present downflow data with upflow data reported in the literature shows that the friction pressure drop for a downflow system is smaller than that for an upflow system, the difference becoming larger as the solids-loading ratio increases. Differences in particle density between the coal and glass beads made comparison of data difficult. The effects of particle shape and size distribution are also difficult to establish. For the conditions of this study, the velocity of fully accelerated coal particles in downward transport is approximately equal to the gas velocity. Since the additional frictional pressure drop caused by the coal particles is only a small portion of the total frictional pressure drop at low solids loadings, the additional frictional pressure drop can be correlated in terms of a particle friction factor, which has a constant value for a particular coal particle suspension.

11433 (EGG—2068) Invert 1.0: A program for solving the nonlinear inverse heat conduction problem for one-dimensional solids. Snider, D.M. (Department of Energy, Idaho Falls, ID (USA). Idaho Operations Office). Feb 1981. Contract AC07-761D01570. 78p. NTIS, PC A05/MF A01.

INVERT 1.0 is a digital computer program written in FORTRAN IV which calculates the surface heat flux of a one-dimensional solid using an interior-measured temperature and a physical description of the solid. By using two interior-measured temperatures, INVERT 1.0 can provide a solution for the heat flux at two surfaces, the heat flux at a boundary and the time dependent power, or the heat flux at a boundary and the time varying thermal conductivity of a material composing the solid. The analytical solution to inversion problem is described for the one-dimensional cylinder, sphere, or rectangular slab. The program structure, input instructions, and sample problems demonstrating the accuracy of the solution technique are included.

11434 (ORNL/CSD/TM—144) Analysis and solution of the ill-posed inverse heat conduction problem. Weber, C.F. (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7406-ENG-26. 37p. NTIS, PC A03/MF A01.

The inverse conduction problem arises when experimental measurements are taken in the interior of a body, and it is desired to calculate temperature and heat flux values on the surface. The problem is shown to be ill-posed, as the solution exhibits unstable dependence on the given data functions. A special solution procedure is developed for the one-dimensional case which replaces the heat conduction equation with an approximating hyperbolic equation. If viewed from a new perspective, where the roles of the spatial and time variables are interchanged, then an initial value problem for the damped wave equation is obtained. Since this formulation is well-posed, both analytic and numerical solution procedures are readily available. Sample calculations confirm that this approach produces consistent, reliable results for both linear and nonlinear problems.

11435 (UVA-ER—607-80U) Waves in rotating fluids (U). Technical report. Cooper, G.R. (Virginia Univ., Charlottesville (USA). School of Engineering and Applied Science). Sep 1980. Contract AC05-760R01779. 63p. NTIS, PC A04/MF A01.

The study of transverse and axial wave motion for a rotating inviscid perfect gas with an impressed temperature gradient and an impressed non-solid body steady state velocity profile is reported. In this investigation, the equations for wave motion are derived using a method similar to that of Hultgren. (Hultgren studied the conditions for linear stability of compressible inviscid swirling shear flows.) The possible wave velocities, mode shapes and pressure distributions are compared to those for the case of isothermal solid body rotation studied by Morton and Shaughnessy. Considerations of mean free path and wave motion are presented for both the impressed temperature distribution and the impressed velocity profile. The modifications on wave velocity, mode shape and pressure due to the mean free path considerations are also given.

11436 **Forced convection heat transfer in rectangular ducts: general case of wall resistances and peripheral conduction.** Lyczkowski, R.W.; Solbrig, C.W.; Gidaspow, D. Chicago, IL; Inst. of Gas Tech. (1980). 35p. (CONF-801102—33).

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

A numerical solution for laminar flow heat transfer between a flowing gas and its containing rectangular duct has been obtained for many different boundary conditions. The problem has been solved for the cases of insulation on no walls, one wall, two walls, and three walls with various finite resistances on the remaining walls. Results have been obtained for several duct aspect ratios in the thermal entrance and in the fully developed regions, including the constant temperature cases. When one wall is insulated and the other three are at constant temperature, the maximum temperature occurs in the fluid rather than on the insulated wall. This maximum moves toward the insulated wall with increasing axial distance. Nusselt numbers for the same constant flux on all four walls with peripheral conduction lie in a narrow band bounded by zero and infinite peripheral conduction cases. A dimensionless wall conduction group of four can be considered infinite for the purpose of estimating fully developed Nusselt numbers to within an accuracy of 3%. A decrease in wall and bulk temperatures by finite wall conduction has been demonstrated for the case of a black body radiation boundary condition.

4205 Materials Testing

11437 **(LA-UR—81-227) Computed tomography for inspection of industrial objects.** Kruger, R.P. (Los Alamos National Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-801241—1). NTIS, PC A02/MF A01.

From 1. workshop on NDE of titanium alloys; Orlando, FL, USA (9 Dec 1980).

The advantages of computed tomography using x-ray or gamma sources for the nondestructive testing of industrial materials, welded joints and equipment such as reactor components are discussed, and the successful use of the Los Alamos tomographic scanner is described. (LCL)

11438 **Industrial applications of computed tomography at Los Alamos Scientific Laboratory.** Kruger, R.P.; Wecksung, G.W.; Morris, R.A. (Univ. of California, Los Alamos, NM). *Optical Engineering ;* **19**: No. 3, 273-282(May 1980).

A research and development program was begun two years ago at the Los Alamos Scientific Laboratory (LASL) to study nonmedical applications of computed tomography. This program has several goals. The first goal was to develop the necessary reconstruction algorithms to accurately reconstruct cross sections of nonmedical industrial objects. The second goal was to be able to perform extensive tomographic simulations with a variety of hardware configurations. The final goal was to construct an inexpensive industrial prototype scanner with a high degree of design flexibility. This paper will describe the implementation of these program goals.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 10523, 11156

11439 **(DOE/NASA/1044—8) Specifying and calibrating instrumentation for wideband electric power measurements.** Lesco, D.J.; Weikle, D.H. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Dec 1980. Contract AI01-77CS51044. 21p. (NASA-TM—81545). NTIS, PC A02/MF A01.

The wideband electric power measurement related topics of electronic wattmeter calibration and specification are discussed. Tested calibration techniques are described in detail. Analytical methods used to determine the bandwidth requirements of instrumentation for switching circuit waveforms are presented and illustrated with examples from electric vehicle type applications. Analog multiplier wattmeters, digital wattmeters, and calculating digital oscilloscopes are compared. The instrumentation characteristics which are critical to accurate wideband power measurement are also described. The major conclusions reached are: electronic wattmeters capable of measuring power in switching circuit applications are available; commercial analytical instruments can be used to determine the power bandwidth requirements; errors are minimized when the current and voltage channels are matched in phase shift, but the matching must include the current transducers and all signal conditioning electronics; and calibration of wideband wattmeters using variable frequency, variable phase sine waveforms is the only NBS-traceable method available.

11440 **(SAND—80-1395) Acceptance criteria for thick film resistors.** Nordstrom, T.V. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 29p. NTIS, PC A03/MF A01.

The goal of this work was to determine the lot-to-lot consistency of thick film resistors. Also, incoming inspection procedures for inks were evaluated. The DuPont BIROX 1400 series resistors were found to be very consistent and reproducible. Recommendations are that material be bought on the standard DuPont certifications. A testing program of ink properties was recommended at Bendix to establish a material data base.

11441 **(SAND—80-1999) SADIST (the SAndia Data Index STructure): a stand-alone data base for computer-aided design and general use.** Stauffer, J.D. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 30p. NTIS, PC A03/MF A01.

A file structure has been designed that fills the needs of multilevel hierarchical design of integrated circuits (ICs). Since the structure is actualized by a stand-alone FORTRAN program, it is applicable to general-purpose use in situations where the structure of the data modeled is similar to that of IC data. Though the structure itself is a FORTRAN direct-access file, its interface with user programs is a small sequential subfile accessible to FORTRAN, PASCAL, and most other languages. This ability facilitates linkup to systems already in use and requires minimal recoding. Backup, restore, and other data base recovery and integrity operations are automatic, but may be initiated by the user if desired. 3 figures.

11442 **(UCID—18919) Use of the Design Station.** Loomis, H.H. Jr. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 3 Feb 1981. Contract W-7405-ENG-48. 48p. NTIS, PC A03/MF A01.

The Design Station is an interactive computer graphics system employing special software to support interactive schematic drawing. Designs specified using this system are typically modest-sized digital systems employing SSI through LSI circuit packages and may involve analog circuit elements. The system not only produces professional quality schematics, it also permits device placement on logic cards. The system produces outputs that can be used as inputs for other design-related programs, such as PC board layout programs, circuit simulation programs like SCEPTRE or NET-2, and ultimately logic simulation programs like LSP. The use of the Design Station is discussed in the context of a sample design. The power and features of the Design Station are illustrated. 45 figures. (RWR)

11443 **Radiation hardness testing for field effect devices.** Pepper, M. (to Plessey Handel Und Investments Ag (Switzerland)). US Patent 4,220,918. 2 Sep 1980. Filed date 22 Mar 1978. vp.

A method is presented for testing a field effect device for radiation hardness. The method comprises the steps of subjecting the field effect device to a low temperature environment, developing a first set of data points by measuring the conductance of the field effect device as a function of gate voltage at a first substrate bias, developing a second set of data points by measuring the conductance of the field effect device as a function of gate voltage at a second substrate bias, which is different from the first substrate bias, and comparing the first and second sets of data points to obtain an assessment of radiation hardness.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 10079, 10212, 10213, 10214, 10215, 10223, 10225

11444 (DOE/RA/20210—4) COSTEAM expansion and improvements: design of a coal-fired atmospheric fluidized bed submodel, an oil-fired submodel and input/output improvements. Reierson, J.D.; Rosenberg, J.I.; Murphy, M.B.; Lethi, M.T. (Mitre Corp., McLean, VA (USA). METREK Div.). Oct 1980. Contract AC01-79RA20210. 220p. NTIS, PC A10/MF A01.

COSTEAM is an interactive computer model designed to estimate the cost of industrial steam produced by various steam plant technologies. At the end of Phase I development, the COSTEAM model included only one submodel to calculate the capital and operating costs of a conventional coal-fired boiler plant with environmental control systems. This report describes the results of Phase II development. Two new submodels are added which calculate costs for steam produced by coal-fired atmospheric fluidized bed boilers and by oil-fired boilers. COSTEAM input/output capabilities are also improved.

11445 Draft tube for wood burning stoves. Evans, A.D.; Leavens, R. (to Mohawk Industries Inc). US Patent 4,222,363. 16 Sep 1980. Filed date 28 Jul 1978. vp.

A draft tube in a wood burning stove is provided with a nozzle at the lower end thereof for directing a portion of the draft air downwardly against the charge of burning wood, coal, etc. And deflects a portion thereof sideways into a zone above the fuel to provide a more complete combustion of the rising volatiles. The nozzle may be integral with the draft tube or may be attached thereto as an accessory. The nozzle includes a tube having an outside diameter somewhat smaller than the inside diameter of the draft tube to define an annular passage therewith when the nozzle is installed. An annular radial flange is mounted on the outside and at the lower end of the nozzle and in line with the annular clearance whereby the major portion of the air and draft will flow directly downwardly through the nozzle tube while a portion passing through the annular passage will strike the flange and be deflected perpendicularly to the flow of the draft.

11446 Heating apparatus having improved combustion. Syme, D.C. (to Vermont Castings Inc). US Patent 4,221,207. 9 Sep 1980. Filed date 7 Jun 1979. vp.

A wood-burning heating apparatus, used as a parlor stove, and providing a significant heat output is disclosed. The stove has primary and secondary combustion chambers and a baffling arrangement for directing flue gases along a circuitous path to the exit aperture whereby a significant proportion of the heat of said gases is given up to the apparatus. A vertically oriented downwardly directed baffle separates the combustion chambers. Primary and secondary air paths supply air to the primary and secondary combustion chambers respectively. Each of the supply conduits is preheated and the secondary air supply provides oxygen substantially evenly around an opening at a bottom portion of the baffle to increase the efficiency of secondary combustion. The apparatus is further provided with a self-clearing top smoke chamber having a pivotable top cover. A rotatable flue collar is provided for either a horizontal or a vertical connection to the exit flue.

11447 Fireplace air heater. Livezey, D.J. (to Therm Air Ind Inc). US Patent 4,220,131. 2 Sep 1980. Filed date 21 Nov 1977. vp.

A blower is attached to the forward end of a tubular base of dihedral form, which extends first along a lower side portion of a fireplace firebox and then along the lower rear portion of the firebox and terminates in a closed end. A short transfer duct extends upwardly from an intermdiate part of the rear portion of the base to an intermediate part of an elevated air-heating box. The air-heating box is elongated in the horizontal direction and leans forwardly. An outlet tube extends forwardly and upwardly from each of its ends to a discharge position at an upper forward corner portion of the fireplace firebox. The side portion of the tubular base includes a flange at its rear end, by which it is bolted to a similar flange at the end of the rear portion of the tubular base. A similar flange is provided at the opposite end of the rear portion of the tubular base and the side portion of the tubular base is invertible so that it can be attached to the opposite end of the rear portion of the tubular base. Lower portions of the flanges serve as support legs for the tubular base. A third point of support is provided at the forward end of the side portion of the tubular base.

11448 Gas-fired radiant burner. Streisel, J.P. (to Barber Mfg Co). US Patent 4,220,132. 2 Sep 1980. Filed date 13 Dec 1978. vp.

A gas-fired radiant heater such as for thawing rail cars and their contents in car barns and the like during freezing weather is presented. The heater has an elongated housing that supports a channel box and an elongated perforated semi-cylindrical mantle supported by the housing over the channel box. The channel box receives a quantity of loosely-packed, fibrous ceramic refractory material that becomes incandescent when heated. The ceramic material has an exposed upwardly facing fibrous surface that defines with the interior of the mantle an elongated combustion chamber. The ends of the combustion chamber are closed and an ignited mixture fuel gas and air is projected into the elongated combustion chamber in the form of a flame jet. The flame jet heats the fibrous ceramic material and the mantle to incandescence so that the upwardly facing surface of the refractory material and the mantle radiate heat energy in a pattern generally normal to the surface of the mantle.

11449 Laser-particulate control for open-cycle, coal fired gas turbines. Botts, T.E.; Powell, J.R. (Brookhaven Natl Lab, Upton, NY). *American Society of Mechanical Engineers, [Paper] ;* No. 79-GT-177, 4(1979).

Direct coal-fired gas turbines need efficient high temperature particulate control in order to be an attractive option for the efficient conversion of coal to electrical energy. Particulates in the range of three to ten microns are very difficult to remove and it is, therefore, proposed that they be fragmented into particulates below the threshold size for turbine blade erosion using pulsed CO_2 lasers. Beam interaction with combustion products is considered. A 1000-MW(e) conceptual plant is presented to demonstrate costs and recirculating power requirements. 8 refs.

4220 Underground Engineering

11450 Method of well fluid leak prevention. Hamilton, H.L. US Patent 4,222,444. 16 Sep 1980. Filed date 6 Dec 1978. vp.

Magnetic material, such as discarded magnetic tape, is ground into small pieces and mixed with well drilling fluids. When the drilling fluids are lost in porous ground, cracks or fissures in the walls of the well, the magnetic tape will accumulate and serve to block the unwanted loss of the fluid. In the event that the fissures are of a size such that the tape will not block the flow, the magnetic properties of the tape may be utilized in combination with a standard well logging instrument to provide an indication of the exact location of the area of fluid loss. At that time, further remedial measures may be taken to block the undesired flow of fluid. For example, a cement slurry may be pumped into the well in the location of the crevices and thus form a permanent seal against loss of fluid.

11451 Mine roof support. Bell, G.; Watermann, W. (to Klockner-Werke Ag (Germany)). US Patent 4,222,686. 16 Sep 1980. Filed date 31 Oct 1978. vp.

A mine roof support is described in which a roof shield, pressed by hydraulically operated, collapsable and extensible props, arranged between the roof shield and a sole plate, against the roof of a mine gallery, is connected at its rear end to a rear shield, which in turn is connected by links to the rear end of the sole plate and in which a hydraulically operated cylinder-and -piston unit is interconnected between the roof shield and the rear shield for controlling the included angle between these shields, an arrangement for stopping further feeding of pressure fluid into the props when the inclined angle between the shield reaches a predetermined minimum or maximum angle.

11452 **Valve arrangement for a walking mine roof support.** Nerlich, E. (to Bochumer Eisenhutte Heintzmann Gmbh And Co (Germany)). US Patent 4,220,424. 2 Sep 1980. Filed date 27 Nov 1978. vp.

A valve arrangement is described for operating a walking mine roof support so as to automatically move the props of the mine roof support first to a collapsed position and advancing the mine roof support and only thereafter moving the props to their extended position and in which control of the valve arrangement is carried out with the pressure fluid which acts on the members of the walking mine roof support.

4230 Marine Engineering

11453 **(LBL—11778) Wave transmission and mooring-force characteristics of pipe-tire floating breakwaters.** Harms, V.W.; Westerink, J.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 131p. NTIS, PC A07/MF A01.

The results are presented of a series of prototype scale tests of a floating breakwater that incorporates massive cylindrical members (steel or concrete pipes, telephone poles, etc.) in a matrix of scrap truck or automobile tires, referred to as the Pipe-Tire Breakwater (PT-Breakwater). Tests were conducted in the large wave tank at the US Army Coastal Engineering Research Center (CERC). Breakwater modules were preassembled at SUNY in Buffalo, New York, and then transported to CERC by truck, where final assembly on location was again performed by SUNY personnel. Wave-tank tests were conducted jointly by CERC and SUNY personnel. A series of wave-tank experiments and mooring system load-deflection tests were performed, and are described. Wave-transmission and mooring-load characteristics, based on 402 separate tests, were established and are reported. (LCL)

11454 **Riser tensioning wave and tide compensating system for a floating platform.** Heeres, C.J.; Larsen, C.H. (to Western Gear Corp). US Patent 4,222,341. 16 Sep 1980. Filed date 11 Jan 1978. vp.

A riser tensioner cylinder is provided with a hollow piston rod which forms a second cylinder in which a ram is reciprocated. The free end of the ram is connected to a link which in turn is connected to the end of the riser for providing tension on the riser. The ram reciprocates in the second cylinder under constant pressure to compensate for wave action on the floating platform and the second cylinder is automatically positioned within the first cylinder for adjustment for tide, vessel offset or other infrequent but variable factors.

11455 **Stabilization of subsea riser pipes having free lower ends.** Person, A.; Wetmore, S.B. (to Global Marine Inc). US Patent 4,221,504. 9 Sep 1980. Filed date 15 Mar 1978. vp.

Apparatus for position stabilizing the lower end of an elongate duct, which is vertically disposable in an ocean and which is supported at its upper end, is described. The apparatus includes an elongate flexible tensile member which is disposable along the interior of the duct. The tensile member is adapted to be connected at one end thereof to a duct support structure and to extend through the duct. A weight of selected mass and size is connectible to the other end of the tensile member below the lower end of the duct. Means are connectible between the tensile member and the duct, at least adjacent the lower end of the duct, for establishing and maintaining a selected position of the tensile member relative to the duct.

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 10282, 10864, 10865, 10866, 10867, 10868, 10869, 11539

11456 **Electrostatically augmented fiber bed and method of using.** Argo, W.B.; Crocker, B.B.; Sisler, C.C. (to Monsanto Co). US Patent 4,222,748. 16 Sep 1980. Filed date 22 Feb 1979. vp.

A method and apparatus for removal of particulates from gas streams with high collection efficiency on even submicron particulates are described. The apparatus includes a grounded fiber bed of 50 to 1000 micron average diameter fibers packed to a bed voidage of at least 90%, an electrostatic or ionizing field means upstream of the fiber bed to place an electrical charge on the particulates, and irrigation means for the fiber bed, and optionally the grounded electrodes of the electrostatic means as well, to flush collected particulates from the fiber bed and optionally from the grounded electrodes. The method is suitable for separation of any particulates but is particularly advantageous for separation of insoluble solid particulates from gas streams at high bed velocities of from 6 to 15 or more feet per second (I.E., 1.8 to 4.6 or more meters per second). The preferred fiber bed is of 100 to 500 micron diameter, and advantageously 100 to 250 micron diameter, glass fibers. In operation, particulates are charged in the electrostatic means and the charged particulates are collected in the fiber bed where the electrical charge is dissipated through the irrigating liquid/particulates mixture so that no significant space charge effect is allowed to develop in the fibers of the fiber bed and re-entrainment of particulates is avoided.

11457 **Process for the removal of sulfur oxides from exhaust gases using slurry of red mud containing calcium ion.** Harato, T.; Shiozaki, Y.; Yamada, K. (to Sumitomo Aluminum Smelting Co (Japan)). US Patent 4,222,992. 16 Sep 1980. Filed date 27 Feb 1979. vp.

A process is given for the removal of sulfur oxides from exhaust gases by absorbing with a slurry of red mud containing calcium ion which comprises the steps of: (1) contacting an exhaust gas containing sulfur oxides of not higher than about 100° C with a slurry of red mud containing calcium ion led from the next step (2) to take up sulfur oxides in the gas until ph of the slurry becomes in the range of 4.3 to less than 6 while maintaining the molar fraction of SO_4-- to total SO_2 in the slurry within the said pH range at 0.05 to 0.7; and then, (2) contacting the treated gas with a fresh slurry of red mud containing calcium ion to further take up sulfur oxides in the gas while maintaining the concentration of $NaHSO_3$ in the slurry at not more than about 8 g/l.

11458 **Catalyst for purifying exhaust and waste gases .** Aoki, Y.; Inoue, A.; Ohara, T.; Ono, T.; Saito, K.; Suzuki, T. (to Nippon Shokubai Kagaku Kogyo Co Ltd (Japan)). US Patent 4,221,768. 9 Sep 1980. Filed date 28 Apr 1978. vp.

A catalyst for purifying exhaust and waste gases, which consists essentially of (A) 30 to 99% by weight of at least one catalytic oxide selected from a binary oxide comprising titanium and silicon and a ternary oxide comprising Ti, Zr, and Si, (B) 1 to 70% by weight of a catalytic oxide comprising at least one element selected from the group consisting of V, W, MO, U, Cu, Fe, Cr, Mn and Ce, and (C) 0 to 50% by weight of a catalytic oxide comprising at least one element selected from the group consisting of Sn, Zn, Pb, Ti, Zr, Ni, Co, Nb, Ta, P, Br, Bi, Sb,, alkali metals, and alkaline earth metals.

43 PARTICLE ACCELERATORS

4302 Beam Dynamics, Field Calculations, And Ion Optics

11459 **(AD-A—087001) Collective acceleration of electrons using autoacceleration process. Memorandum report.** Lockner, T.R.; Friedman, M. (Naval Research Lab., Washington, DC (USA)). Jul 1980. 32p. NTIS, PC A03/MF A01.

A means of collectively accelerating an intense electron beam is demonstrated. A long pulse (800ns) electron beam is propagated through cavity structures which redistributed the energy in the beam such that most of the beam energy is transferred to a short segment (6 nsec) in the tail of the beam; Electrons are accelerated in a two cavity system from 200 KeV to energies of 2.4 - 3.0 MeV at a beam current of approx. 8 kA. The extension of this principle to larger number of cavities appears feasible.

11460 **(AD-A—087055) A 1-d computer simulation model of collective ion acceleration by linear electron beams. Technical report.** Sternlieb, A.; Ulm, H.S. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). May 1979. 35p. NTIS, PC A03/MF A01.

A 1-d electrostatic and relativistic particle code has been built in order to simulate a self-consistent way the time-dependent behavior of collective ion acceleration produced by linear electron beams injected into evacuated drift tubes. The simulation results agree with existing experimental and theoretical results by showing good current propagation and high ion energy gain in the presence of a well-localized plasma source at the e-beam injection boundary. Moreover, the simulations display an unexpected phenomenon, the appearance of short-lived regions of positive electrostatic potential (virtual anodes) which together with the usual virtual cathodes, contribute to the ion acceleration mechanism. In the absence of a suitable analytical theory, it seems to us that the present computer model is an indispensable tool for reliable explanation and optimization of present and future collective ion acceleration experiments. Use of our model in laser-plasma experiments in suggested.

11461 (SLAC-PUB—2624, pp 144-164) **Beam-beam simulation for the single-pass linear collider.** Sah, R. (Lawrence Berkeley Lab., Berkeley, CA). Oct 1980.

From Seminar on the beam-beam interaction; Stanford, CA, USA (22 May 1980).

The beam-beam interaction for the single-pass linear collider has been simulated by means of a computer calculation. This work is similar to that done by Robert Hollebeek at SLAC, but the two simulations were done independently.

11462 (SLAC-PUB—2624, pp 165-204) **Disruption limits for linear colliders.** Hollebeek, R. (Stanford Linear Accelerator Center, CA). Oct 1980.

From Seminar on the beam-beam interaction; Stanford, CA, USA (22 May 1980).

Beam behavior in a single-pass collision device has been investigated using a cloud-in-cells plasma simulation code. The intense electromagnetic fields of the beams produce mutual focusing effects whose strength is determined by the disruption parameter D. The consequent decrease in the beam radii causes an increase in the luminosity of a single collision. The dependences of the beam behavior on beam profiles and current density are described. The beam behavior is stable for several plasma oscillations and indicates that high luminosity can be achieved in single-pass collision devices by using intense beams.

11463 (SLAC-PUB—2624, pp 235-247) **Measures of nonintegrability in two-dimensional mappings.** Greene, J.M. (Plasma Physics Lab., Princeton, NJ). Oct 1980.

From Seminar on the beam-beam interaction; Stanford, CA, USA (22 May 1980).

The method of two-dimensional mapping as a way of modelling beam-beam interactions is described. (GHT)

11464 **Proposed method for the transport of ions in linear accelerators utilizing electron neutralization.** Humphries, S. Jr.; Poukey, J.W. (Sandia Labs., Albuquerque, NM (USA)). *Particle Accelerators ;* **10**: No. 2, 107-123(1980).

A geometry is proposed in which it may be possible to introduce electrons into ion beams within a linear-accelerator structure. In the configuration, electrons are controlled by solenoidal magnetic fields of moderate intensity; the electron flow guides the ion beam electrostatically, eliminating the need for direct magnetic focusing. Such systems may be capable of containing ion beams at levels up to the kiloampere range. Models are given for electron neutralization of ion beams over short time scales, the focusing properties and current transport limits for the electron-flow geometry, and the orbital stability of beams.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 10959, 11365, 11381, 11477, 11749

11465 **(AD-A—086493) Collective ion acceleration and electron beam propagation in dielectric guides. Annual report 1 Feb 79-31 Jan 80.** Halverson, W.; Greenwald, A.C. (Spire Corp., Bedford, MA (USA)). 1 Apr 1980. 41p. NTIS, PC A03/MF A01.

Measurements of front velocity and transported electron beam current are reported for several configurations of dielectric guide. It appears that the ions which determine the speed of beam-front propagation come only from a short section of dielectric near the inlet of the guide. They are accelerated in the potential well of the virtual cathode formed when the space-charge-limited electron beam is injected. Plasma formed by electron bombardment of the downstream guide walls apparently does not influence the beam-front speed, although it is important in determining the efficiency of current transport. Measurements of collective ion acceleration have been deferred until the second year of the program.

11466 **(ANL—81-5) Plan for the future of neutron research on condensed matter: an Argonne National Laboratory report prepared in response to the Report of the Review Panel on Neutron Scattering.** (Argonne National Lab., IL (USA)). 27 Jan 1981. Contract W-31-109-ENG-38. 31p. NTIS, PC A03/MF A01.

The Review Panel on Neutron Scattering has recommended an expanded budget to allow systematic development of the field. An alternative plan for the future of neutron research on condensed matter is presented here, in case it is not possible to fund the expanded budget. This plan leads, in a rational and logical way, to a world-class neutron source that will ensure the vitality of the field and exploit the many benefits that state-of-the-art neutron facilities can bring to programs in the materials and biological sciences. 2 tables. (RWR)

11467 **High resolution magnetic spectrometer for antiproton physics at rest and low energies.** Lowenstein, D.I. (Brookhaven National Lab., Upton, NY (USA)); Lewis, R.A.; Miller, R. (Michigan State Univ., East Lansing (USA)). pp v.2 p.669-682 of Proceedings of the 4. European antiproton conference. Barr, 25-30 Jun 1978. Fridman, A. (comp.). Paris, France; Centre National de la Recherche Scientifique (1979).

From 4. European antiproton symposium; Barr, France (25 Jun 1978).

A spectrometer is being installed in a high intensity antiproton beam (LESBII) at the AGS. The beam momentum entering the target will be known to approximately +- 1/2%. The target is surrounded by a stereoscopic cylindrical drift chamber and thus the total charge of the event will be measured. The vertex will be reconstructed with an acccuracy of approximately +- 2 mm, allowing studies of annihilations with high resolution down to approximately 150 MeV/c. On one side of the target a large aperture (2.3 x .62 m^2) magnet, covered on both sides with drift chambers and triggering - TOF scintillation counters, will measure particle and γ-ray energies with high resolution, as well as identify particles. The primary objective is to look for peaks in the γ-spectra coming from annihilations at rest by converting them in a thin (.05 x_0) radiator before the magnet. Narrow peaks (< 1 MeV) which are produced with frequencies of approximately 10^{-3} or better are expected to be seen as 5sigma effects. The principle and details of the spectrometer are presented.

11468 **(LA-UR—80-2969) Instrument development for materials science research at WNR.** Eckert, J.; Silver, R.N.; Soper, A.; Vergamini, P.J.; Goldstone, J.; Larson, A.; Seeger, P.A.; Yarnell, J. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 34p. (CONF-8010141—1). NTIS, PC A03/MF A01.

From ICANS IV conference; Tsukuba, Japan (20 Oct 1980).

The neutron scattering program at the Los Alamos spallation neutron source is based on the operational WNR facility which provides up to 11 μA of 800 MeV protons to a target in pulse widths up to 8 μs at 120 Hz. The immediate goals of the program are: to gain experience with neutron instrumentation at spallation neutron sources; and to explore the scientific potential for

condensed matter research at these sources. The proton storage ring (PSR) funded for construction will provide 100 μA in 0.27 μs pulses at 12 Hz, therefore greatly improving intensity, time-of-flight (TOF) resolution, and repetition rate. The initial emphasis, given limited manpower and resources, has been placed on developing a set of prototype instruments which are relatively easy to implement and which take advantage of the unique characteristics of the present WNR when compared with reactor neutron sources.

11469 **Drift tube suspension for high intensity linear accelerators.** Liska, D.J.; Schamaun, R.G.; Clark, D.C.; Potter, R.C.; Frank, J.A. (to Dept. of Energy). US Patent Application 129,299. 11 Mar 1980. 8p.

The disclosure relates to a drift tube suspension for high intensity linear accelerators. The system comprises a series of box-sections girders independently adjustably mounted on a linear accelerator. A plurality of drift tube holding stems are individually adjustably mounted on each girder.

11470 **Stresses in warm iron superconducting dipoles utilizing general elastic constants.** Snowdon, S.C. (Fermi National Accelerator Lab., Batavia, IL (USA)). *Particle Accelerators ;* **10**: No. 2, 83-99(1980).

Calculations are presented which are suitable for estimating mechanical and thermal stresses in superconducting dipoles being built at Fermilab. For the geometrical structure chosen the calculations are analytically exact though the structure only approximates the physical structure of the Doubler dipole and the beam-line dipoles. The stresses calculated include those resulting from prestrain, cooldown, and magnetic-field excitation. The calculation utilizes elastic constants possessing locally orthotropic symmetry which permits a realistic representation of the subdivision of superconductors into cables and a solution to the elastic equilibrium equations has been found utilizing these elastic constants in a composite.

4304 Storage Rings

11471 **(LBL—12006) Recent high precision surveys at PEP.** Sah, R.C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1980. Contract W-7405-ENG-48. 12p. (CONF-810211—1). NTIS, PC A02/MF A01.

From American Society of Photogrammetry and the American Congress on Surveying and Mapping convention; Washington, DC, USA (22 Feb 1981).

The task of surveying and aligning the components of PEP has provided an opportunity to develop new instruments and techniques for the purpose of high precision surveys. The new instruments are quick and easy to use, and they automatically encode survey data and read them into the memory of an on-line computer. When measurements of several beam elements have been taken, the on-line computer analyzes the measured data, compares them with desired parameters, and calculates the required adjustments to beam element support stands.

44 INSTRUMENTATION

4401 Radiation Instrumentation

11472 **(AD-A—086076) Evaluation of the energy and angular dependence of the Victoreen models 470A and 471 survey meters. Technical report.** Prado, K.L. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). 20 Feb 1980. 20p. NTIS, PC A02/MF A01.

The angular and energy dependence of the Victoreen models 470A and 471 have been evaluated. The instruments were exposed to x-rays of 9, 21, 42, 64 and 120 keV effective energies as well as to CS-137 gamma rays. Instrument response was also evaluated as a function of incident radiation angle between 0 degrees and 90 degrees. Both instruments met or exceeded manufacturer's performance specifications.

11473 **(AD-B—951766) Operation Plumbbob. Project 2.6. Evaluation of new types of radiac instruments. Report for May-Oct 57.** (General Electric Co., Santa Barbara, CA (USA)). 1 Oct 1979. 69p. NTIS, PC A04/MF A01.

The objectives of this project were to evaluate the response of newly developed gamma-neutron dosimeters and the field operational adequacy of a new beta-gamma ion-chamber rate meter. It was concluded that the neutron-dosimeter system tested was subject to some effect, probably a neutron dose rate dependency, which caused the loss of accuracy. The recommendation is made for more laboratory study of this effect and the dosimeter system.

11474 **(ORNL/TM—7123) Monte Carlo simulation of an actual segmented calorimeter: a study of calorimeter performance at high energies.** Gabriel, T.A.; Bishop, B.L.; Goodman, M.S.; Sessoms, A.L.; Eisenstein, B.; Wright, S.C.; Kephart, R.D. (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-26. 25p. NTIS, PC A02/MF A01.

The calculated responses including energy resolution, angular resolution, and spatial energy deposition of a segmented iron and liquid-argon calorimeter to incident pions in the energy range of 10- to 250-GeV are presented. Experimental data for this calorimeter have been obtained in the 10- to 40- GeV energy range and these results compare favorably with the calculated data.

11475 **(PB—80-184336) A thermoluminescence dosimetry system for use in a survey of high-energy Bremsstrahlung dosimetry. Final report for 1978 and 1979.** Ehrlich, M.; Soares, C.G. (National Measurement Lab. (NBS), Washington, DC (USA)). May 1980. 50p. NTIS, PC A03/MF A01.

This is the final report covering the work performed under an interagency agreement between the National Bureau of Standards and the Bureau of Radiological Health during the fiscal years 1978 and 1979. A thermoluminescence dosimetry system suited for a survey of high-energy bremsstrahlung in U.S. radiation-therapy departments was selected and calibrated. The experiments leading to the choice of the recommended operational characteristics, including dosimeter handling, annealing and readout, dosimeter stability in the contemplated mode of operation, dosimeter response over the photon-energy range to be covered, irradiation geometry and irradiation level are treated in detail. Results are reported of a pilot study involving the shipment of a typical survey assembly (a plastic phantom loaded with a set of dosimeters) for irradiation in one U.S. therapy department and the overall uncertainty of the proposed survey procedure is discussed.

11476 **(UCID—18888) UNSPEC: revisited (semaphore code).** Neifert, R.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Jan 1981. Contract W-7405-ENG-48. 26p. NTIS, PC A03/MF A01.

The UNSPEC code is used to solve the problem of unfolding an observed x-ray spectrum given the response matrix of the measuring system and the measured signal values. UNSPEC uses an iterative technique to solve the unfold problem. Due to experimental errors in the measured signal values and/or computer round-off errors, discontinuities and oscillatory behavior may occur in the iterated spectrum. These can be suppressed by smoothing the results after each iteration. Input/output options and control cards are explained; sample input and output are provided. (RWR)

11477 **Performance of the lead/liquid argon shower counter system of the Mark II detector at SPEAR.** Abrams, G.S. (Univ. of California, Berkeley); Blocker, C.A.; Briggs, D.D. Contract W-7405-ENG-48. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science (Formerly IRE (Institute of Radio Engineers) Transactions on Nuclear Science) ;* **NS-27**: No. 1, 59-63(Feb 1980).

The shower counter system of the SLAC-LBL Mark II detector is a large lead/liquid argon system of the type pioneered by Willis and Radeka; however, it differs in most details and is much larger than other such detectors currently in operation. It contains, for example, 8000 liters of liquid argon and 3000 channels of low noise electronics, which is about eight times the size of the system of Willis et al in the CERN ISR. This paper reports, with little reference to design, on the operation and performance of the Mark II system during approximately a year and a half of operation at the Stanford Linear Accelerator Center's e^+-e^- facility, SPEAR. The design and construction of the system have previously been described and a detailed discussion of all aspects - design, construction, operation, and performance - is in preparation.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

11478 (AD-A—085817) TREE simulation facilities, second edition. Rosenfeld, J.V. (General Electric Co., Santa Barbara, CA (USA)). 1 Jan 1979. 607p. NTIS, PC A99/MF A01.

It is the purpose of this document to provide persons working in this area of transient radiation effects on electronics (TREE) with a reference document which characterizes on a technical basis TREE Simulation Facilities. Pulse reactors, flash X-rays, and LINACs are each characterized on an individual basis. The material is arranged to provide the TREE experimenter with the facility information he would need to know in order to run an experiment at one of the facilities.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 10214, 10215, 11284, 11563, 11618, 11623

11479 (BDX—613-2550) Calibration intervals at Bendix Kansas City. James, R.T. (Bendix Corp., Kansas City, MO (USA)). 1980. Contract AC04-76DP00613. 8p. (CONF-8009122—1). NTIS, PC A02/MF A01.

From NCSL workshop and symposium; Gaithersburg, MD, USA (22 Sep 1980).

The calibration interval evaluation methods and control in each calibrating department of the Bendix Corp., Kansas City Division is described, and a more detailed description of those employed in metrology is provided.

11480 (SAND—80-2126) Performance of a commercial backscatter instrument adapted for noncontacting areal density measurements on small-diameter surfaces. Higgins, P.B. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1980. Contract AC04-76DP00789. 27p. NTIS, PC A03/MF A01.

Measuring the local areal density of a sensitive explosive deposited on a small-diameter surface requires noncontacting technique and good resolution. The side effects of spacing the sensing platen of an NX-500 Betascope 2.54 mm from the surface of cylinders as small as 13-mm diameter are examined. Resolution in two directions and offset error sensitivity of the system are defined and determined using coatings of simulated explosive. An eddy-current system is described which can be easily added to reduce offset errors caused by fixture misalignment.

11481 Stress measurement and bolt tensioning by ultrasonic methods. Smith, J.F.; Greiner, J.D. (Ames Lab., IA). *Journal of Metals ;* **32**: No. 7, 34-36(Jul 1980).

In the past decade, a new technique has been developed for measuring tensile stresses in solids. This ultrasonic technique has been used thus far primarily for measuring fastener tension. The precision of measurement is routinely to 2-3% and, with special care, to approx. 1%. The method is insensitive to the frictional losses which plague tensioning by torque wrench. Though the approach is relatively new, it promises a wide range of applicability.

11482 Data acquisition, reconstruction and display for the Donner 280-Crystal Positron Tomograph. Huesman, R.H.; Cahoon, J.L. (Univ. of California, Berkeley). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science (Formerly IRE (Institute of Radio Engineers) Transactions on Nuclear Science) ;* **NS-27**: No. 1, 474-478(Feb 1980).

The imaging system for the Donner 280-Crystal Positron Tomograph is described. The architecture of the hardwired data acquisition system (histogrammer) allows a data rate in excess of two million events/second while simultaneously correcting for accidental events. The histogrammer has eight memory cards to allow separate accumulation of time-slices of the cardiac cycle, or multiple-buffering for rapid sequential studies. Transfer time from the double-bussed histogrammer to a disk of the host computer system is less than one second. A hardwired device is able to reconstruct a 256 x 256 image from 140 angles in less than three seconds, but since calibration and correction for attenuation are presently performed in software, this time is increased to about 10 seconds. Images are displayed on a 256 x 256 raster scan display system with image manipulation capabilities.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

11483 (MHSMP—81-01(Rev.2/81)) Compositional analysis of LX-09. Richardson, B.R. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Feb 1981. Contract AC04-76DP-00487. 8p. NTIS, PC A02/MF A01.

A compositional analysis procedure for LX-09 is presented. A gravimetric procedure is used to determine HMX content, and a liquid chromatographic technique used for the FEFO content. The PDNPA is determined by difference. An alternate method for the binder content is presented and drawbacks to each analysis of the binder are discussed.

11484 (MHSMP—81-07) Assay of HNS by liquid chromatography with the use of an internal standard. Process development endeavor No. 101. Schaffer, C.L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Jan 1981. Contract AC04-76DP00487. 8p. NTIS, PC A02/MF A01.

An improved method for the assay of hexanitrostilbene (HNS) by liquid chromatography was developed using an internal standard of benzotrifuraxan (BTF). An eluant of 75% heptane, 5% acetonitrile and 20% glyme was found to give the highest resolution of those eluants investigated using a μBondapak NH_2 column.

11485 (MHSMP—81-12) Re-establishment of friction sensitivity as a standard test. Process development endeavor No. 301. Demerson, E.L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Feb 1981. Contract AC04-76DP00487. 13p. NTIS, PC A02/MF A01.

The friction sensitivity test was re-established following movement of the machine to a new location required by intraline distance considerations. An epoxy resin without silver was evaluated for bonding the silica sand to the initiation strap. The epoxy without silver was found to give more reproducible results than the previous epoxy containing silver. The friction sensitivities of fourteen explosives were determined.

11486 (MHSMP—81-13) HIAC PA-720 system for particle size analysis. A technical evaluation. Cox, L.A.; Giberson, R.C. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Feb 1981. Contract AC04-76DP-00487. 23p. NTIS, PC A02/MF A01.

The purpose of this evaluation was to compare the results obtained from the HIAC PA-720 system for Particle Size Analysis with those from the wet-sieving method and the Millipore IIMC computer method currently in use in the Pantex Quality Control Laboratory. Economic factors have also been considered in this evaluation. The HIAC PA-720 system results showed mean and median particle diameters that were within 5.0% of those obtained from current methods.

11487 (MHSMP—81-14) Nitration of sym-trichlorobenzene. Quinlin, W.T. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Feb 1981. Contract AC04-76DP-00487. 11p. NTIS, PC A02/MF A01.

Basic thermal and kinetic data were obtained for the nitration of 1,3,5-trichlorobenzene to trichlorotrinitrobenzene in the presence of oleum/nitric acid. A limiting specific production rate of 5.4 kg/l/hr was determined for the addition of the first two nitro groups at 130 C and a rate of 0.16 kg/l/hr was obtained at 150 C for the addition of the third nitro group.

11488 Optical flame and explosion detection system and method. Bright, C.I. (to Systron-Donner Corp). US Patent 4,220,857. 2 Sep 1980. Filed date 1 Nov 1978. vp.

an optical flame and explosion detection system is described that has first and second channels with each of the channels being

responsive to different combustion products and detecting radiation from the combustion products and converting the radiation into electrical signals. A filter is provided in each of the channels to limit the spectral response to a narrow band. The levels of the radiation are ascertained by level detectors which provide first and second signals when predetermined signal levels are reached in the first and second channels. A ratio of the two electrical signals from the first and second channels is ascertained. When a predetermined level is reached from the ratio of the electrical signals and also for the individual signals, an output signal is produced which can be utilized in actuating alarms and other devices.

4502 Nuclear

REFER ALSO TO CITATION(S) 10390, 11473

11489 **(AD—363623) Barometric and water-surface waves produced by Mike shot.** Bascom, W.; Munk, W.; Van Dorn, W. (Scripps Institution of Oceanography, La Jolla, CA (USA)). Jun 1953. 38p. NTIS, PC A $6.00.

Barometric and water-surface waves generated by Mike shot were studied by means of 25 instruments in 19 locations in the Pacific Basin ranging from 12 to 4600 nautical miles from Ground Zero. Several new kinds of instruments were constructed and used, and deep-sea instrument stations were installed on the tops of two mounts. The first water waves arriving at Eniwetok Island apparently traveled along paths outside the lagoon. At several of the stations there were two distinct arrivals of water waves, the first apparently being driven by the propagated rise in atmospheric pressure caused by the explosion and thus traveling at the speed of sound and the second moving along the water surface in the usual manner at a velocity of the square root of gh. At the distant island stations a long-continued persistence of wave activity substantially above background was observed, modulated by sporadic enhancements that suggest reflections from major land masses.

11490 **(AD—374634) Scientific director's report of atomic weapon tests at Eniwetok, 1951. Annex 6.3. Combat vehicle exposure.** Berning, W.W.; Arnold, N.W. (Ballistic Research Labs., Aberdeen Proving Ground, MD (USA)). Aug 1952. 287p. NTIS, PC A $16.00.

Two M-46 and eight M-26 medium tanks were exposed to E-shot in Operation Greenhouse. These vehicles were located at ranges of 500, 750, 1000, 1233, and 1400 yd from ground zero, with various orientations relative to the burst point. The effects on crew members are considerably more serious than those on the vehicle itself. Within those vehicles rendered unfit for combat by violent displacement, complete crew casualty is immediate. At greater ranges from ground zero, lethal radiation dosages are incurred by the crew when the medium tank suffers no impairment of combat effectiveness. The effects of blast pressures within the crew compartment are of little consequence. Briefly the results may be given as follows: (1) Combat effectiveness of vehicle alone: 0%, 0 to 500 yd; 0 to 100%, 500 to 1000 yd; 100% at distances greater than 1000 yd; (2) Immediate combat effectiveness of crew: 0%, 0 to 900 yd; 0 to 100%, 900 to 1100 yd; 100% at distances greater than 1100 yd; and (3) Delayed combat effectiveness of crew (periods greater than 24 hr): 0%, 0 to 1200 yd; 0 to 100%, 1200 to 1600 yd; 100% at distances greater than 1600 yd.

11491 **(AD-A—086087) Airblast pressure transducer for measurements in nuclear blast simulators. Final report.** Quintana, J.V. (Air Force Weapons Lab., Kirtland AFB, NM (USA)). Apr 1980. 33p. NTIS, PC A03/MF A01.

An extremely rugged resistance-based blast pressure transducer is developed over a number of years for use in the blast and shock environment of high explosive-driven nuclear blast simulators. A novel silicon disk with integral (diffused) strain sensitive regions is used as the transduction element for measurements of peaks to 69 MPa and requiring microsecond rise time response. Evolution of the transducer geometry, internal configuration, and special thermal barriers enable sensing applications in extremely violent shock environments to 50 kgs with intense flash and burn thermal environments. A variety of transducer mounting hardware configurations enables side-on sensing of incident overpressure and head-on sensing of reflected and stagnation pressures in a variety of simulator field test configurations.

11492 **(AD-A—086210) Continuation of static tests of segments of tunnel linings. Volume II data. Final report 21 Nov 77-30 Jun 79.** Davis, H.C.; Morrill, K.B.; Merritt, J.L. (Merritt Cases, Inc., Redlands, CA (USA)). 30 Jun 1979. 519p. NTIS, PC A22/MF A01.

Volume II presents the complete set of laboratory data obtained from a continuation series of 19 quasi-static tests of segments of cylindrical tunnel linings. Test specimens included scale models of a composite-integral structure and a steel structure with backpacking fielded in the MIGHT EPIC/DIABLO HAWK structures experiments and a corrugated structure with backpacking fielded in PILE DRIVER Event. Also included were two additional structural concepts: a steel fiber reinforced concrete model and a composite-integral model with backpacking.

11493 **(AD-A—086211) TWCP electron beam testing program. Volume I. Summary. Final report Jul 77-Dec 78.** Bick, F.A. (Effects Technology, Inc., Santa Barbara, CA (USA)). 5 Apr 1979. 72p. NTIS, PC A04/MF A01.

This is Volume I of four volumes. The results of a series of electron beam tests are summarized that: (1) characterized the Maxwell Laboratory's Blackjack III pulsed electron beam facility for material response studies related to nuclear weapons effects on reentry vehicle heat-shield materials; (2) developed a set of instrumentation to diagnose the electron beam environment and measure material response as to impulse and stress generation; and (3) generated impulse and stress data on FM5822A carbon phenolic and 91-LD phenolic resin materials. The data generated demonstrated the utility of the Blackjack III facility and will be used in a separate program entitled, 'TWCP Correlation Program.' The instrumentation developed are applicable to these types of tests on a variety of facilities. The environmental diagnostical instrumentation achieved a significant reduction in experimental uncertainties when compared to prior techniques. This program was conducted within the framework of the Nuclear Hardness Evaluation Procedures Program and the concepts developed therein.

11494 **(AD-A—086212) Approximate probabilistic methods for survivability/vulnerability analysis of strategic structures. Final report 1 Jun 77-15 Jul 78.** Ang, A.H. (Newmark (Nathan M.) Consulting Engineering Services, Urbana, IL (USA)). 15 Jul 1978. 97p. NTIS, PC A05/MF A01.

The major concepts and methods of probability and statistics that are of special significance to engineering are summarized, with emphasis on the potential applications in strategic structures problems. Approximations to well-established exact mathematical methods of probabilistic analysis were developed; these approximations are necessary for a sensible and effective implementation of the essential concepts in engineering, in the sense that they lead to simplifications that are consistent with the state and quality of available information, which (in practice) invariably must include subjective judgments. Applications in the development of probability-based relationships for the design of strategic structures were stressed; the required relationships can be developed so that the conventional (i.e. deterministic) methods of design may be retained. In particular, these may be in the form of safety factors that can be used in a conventional design format, in order to achieve a desired survivability in terms of a probability of survival. Similar relationships for target planning are also developed, and their significance identified and discussed. Several examples of strategic structural problems are developed to demonstrate the basic approach.

11495 **(AD-A—086214) TWCP electron beam testing program. Volume IV. TWCP electron beam tests. Final report Jul 77-Dec 78.** Bick, F.A. (Effects Technology, Inc., Santa Barbara, CA (USA)). 5 Apr 1979. 134p. NTIS, PC A07/MF A01.

This volume presents impulse and stress generation data on FM5822A tape wrapped carbon phenolic and 91-LD phenolic resin using the techniques described in Volumes II and III. Preliminary data analysis is presented, however, the final utility of these data is to be determined through the 'TWCP Correlation Program.' Data were generated at a peak electron energy of approximately 1-MeV

and at fluence levels ranging from approximately 70 to 120 cal/sq cm. By a unique in situ diagnostical technique, the experimental errors associated with the beam parameters (fluence, peak dose) were approximately halved when compared with prior test programs for this type of facility.

11496 **(AD-A—086216) Fallout hazard prediction inconsistencies. Final report 1 Oct 78-1 Oct 79.** Hawthorne, H.A. (General Electric Co., Santa Barbara, CA (USA)). 1 Oct 1979. 109p. NTIS, PC A06/MF A01.

An elementary review of modelling of fallout processes is presented, with lists of some of the important variables that modules within models are called on to parameterize. A brief historical synopsis of the development of modelling includes a description of efforts with a standardized input data to produce output directly comparable among models, including illustrations of the output over the nuclear yield range of less than 1 KT to 15 MT. Model output is compared to observed data from field weapons tests, and estimates are made of the degree of fit between observed nuclear data and predicted parameters from models.

11497 **(AD-A—086217) Asymmetric collapse of LOS pipe. Final report 28 Feb-31 May 77.** Moore, E.T. Jr.; Funston, R. (Physics International Co., San Leandro, CA (USA)). 17 Jul 1979. 153p. NTIS, PC A08/MF A01.

Laboratory experiments are described that were performed to investigate the potential of using asymmetries to inhibit the formation and progression of high energy jets from the collapse of thin-walled metal tubes. The experiments were designed to simulate the collapse of a line-of-sight (LOS) pipe in an underground nuclear test. Results indicate that helical asymmetries on the internal surface of the tubes may eliminate or suppress jetting.

11498 **(AD-A—086218) Effects of debris entrainment and multi-phase flow on plug loading in an MX trench. Final report 1 May-31 Oct 77.** Rosenblatt, M.; Carpenter, G.E.; Bilyeu, R.P. (California Research and Technology, Inc., Woodland Hills (USA)). 15 Sep 1978. 44p. NTIS, PC A03/MF A01.

The 1 - 1/2-D version of the multi-phase DICE code was used to analyze the flow of hot air and wall debris in covered MX trenches after an on-line burst. In DICE, debris particles are coupled to the air flow by thermal and drag mechanisms. The objective was to examine the effects of major uncertainties in the timing and magnitude of wall removal and debris entrainment upon the pressure and impulse loading on a rigid plug in the trench. The contributions to impulse due both to pressure loading and the momentum of the debris mass were considered. Transfer of momentum and energy from the hot gas flow to the debris attenuates pressures and velocities. In all cases treated, the maximum pressure and impulse calculated on the plug were substantially lower than would be the case if no debris were present (i.e., if the flow in the trench consisted only of hot air). Where debris mass became entrained near the shock (say within 20-50 feet after the shock passes), plug loading was reduced by orders of magnitude. For example, entrainment of the debris from 0.15-in. of wall recession (with entrainment starting 18 feet behind the shock) reduced the maximum pressure on the plug from 6800 to 78 bars and the impulse from 24 to 3 bar-sec (as compared to air-only flow in the trench). Techniques to enhance early entrainment would be useful in reducing the design load on plugs. Debris not entrained until 100 feet or more behind the shock front has a much smaller effect on plug loading.

11499 **(AD-A—086219) Feasibility investigation of a permanent fuel-air explosive blast simulator. Topical report 9 May 77-9 Aug 78.** Sedgwick, R.T.; Kratz, H.B.; Herrmann, R.G. (Systems, Science and Software, La Jolla, CA (USA)). 9 Aug 1978. 146p. NTIS, PC A07/MF A01.

Initial results from an investigation to determine the feasibility of using fuel-air-explosives (FAE) to simulate the airblast from a 1 KT nuclear blast are reported. A small scale blast facility was developed and tested. Up to 22.7 kg (50 lbs) of fuel such as propylene oxide can be disseminated through a hemispherical nozzle head containing 600 nozzles to form 9.14 m (30 ft) diameter hemispherical clouds which are subsequently detonated. The measured pressure history and impulse from several experiments were scaled and compared with 1 KT nuclear blast wave data. These initial results indicate that FAE can be used to simulate nuclear blast waves and that continued effort to develop the technology required to design a permanent, reuseable 1 KT FAE nuclear blast wave facility is therefore warranted.

11500 **(AD-A—086590) Transmission factor effects on the average forward range of Compton electrons. Technical memo.** Wyatt, W.T. Jr. (Harry Diamond Labs., Washington, DC (USA)). Jan 1980. 12p. NTIS, PC A02/MF A01.

Compton electrons generated in air by gamma rays produced by nuclear explosions are known to cause transient electromagnetic fields called the electromagnetic pulse (EMP) or radioflash. The average forward range of the Compton electrons in air is a principal factor governing the strength of the EMP. Previous estimates of the average forward range of Compton electrons were based on an energy-independent electron transmission factor. This investigation uses an energy-independent electron transmission factor to obtain more accurate results. Results from the two methods are in agreement for an incident gamma energy of 1.5 MeV, and disagree by 7 and 10 percent for incident gamma energies of 0.3 and 10.0 MeV, respectively. Simple numerical fits to the new results are included.

11501 **(AD-A—087316) The local environment resulting from a massive nuclear attack on Whiteman Air Force Base. Final technical report.** Hulburt, C.W.; Yutko, C.A.; Sullivan, R.J. (System Planning Corp., Arlington, VA (USA)). Apr 1980. 52p. NTIS, PC A04/MF A01.

The study examines the potential blast and fallout damage that would be sustained by the 15 counties surrounding the Whiteman Air Force Base in Missouri following a nuclear attack against the associated Minuteman missile silos. The study also provides recommendations concerning the shelters that would be required to protect the population of these 15 counties from blast effects and heavy fallout. The study was performed in consonance with the new emphasis that FEMA (Federal Emergency Management Agency) is giving to nuclear civil protection in counterforce areas. It is intended to be a prototype for analyses of areas containing other U.S. counterforce targets, notably the other five Minuteman wings, the Titan missiles, the Strategic Air Command bases, and the strategic submarine bases.

11502 **(AD-B—951745) Operation Plumbbob. Project 1.2. Field test of a system for measuring blast phenomena by airborne gages. Preliminary report May-Sep 57.** (General Electric Co., Santa Barbara, CA (USA)). 1 Feb 1980. 27p. NTIS, PC A03/MF A01.

Project 1.2 participated in Operation Plumbbob in order to proof test prototype air-blast instrumentation for Operation Hardtack and to train personnel in handling this experiment under field conditions. The air-blast systems consisted of (1) parachute-supported canisters containing self-recording mechanical pressure gages that were deployed by means of rockets and (2) balloon-supported pressure instrumentation. The pressure and recording equipment were used with both the balloon and rocket systems. Pressure-time records were obtained in all cases except one. In one of the rockets a pressure record was not obtained, due to a failure in the electrical system. There were several defects noted in the system, none of which are considered serious. The general performance of the system was satisfactory. It was concluded that the basic design was sound.

11503 **(AD-B—951746) Operation Tumbler-Snapper. Project 7.2. Detection of airborne low-frequency sound from atomic explosionsl Repot for Apr-Jun 52.** (General Electric Co., Santa Barbara, CA (USA)). 1 Feb 1980. 41p. NTIS, PC A03/MF A01.

Measurements of the airborne low-frequency sound from the atomic explosions of Operation TUMBLER-SNAPPER (April, May, and June, 1952) were made at seven remote locations covering a variety of directions and distances from the Nevada Proving Grounds in order to establish the range and accuracy of location of acoustic long-range detection equipment. All shots except the first two were detected at least to 3700 kilometers from the test site. Results for Shot 1 were negative but the closest station for this test

was at 3400 kilometers. Shot 2 was detected at 1300 km but not at 2500 km. A shift in preferred direction of transmission was noted with westward propagation preferred after the middle of May. Data are consistent with expected seasonal changes in east-west wings in the stratosphere.

11504 **(AD-B—951747) Operation Tumbler-Snapper. External neutron measurements. Projects 17.1 and 17.2. Report for Apr-Jun 52.** Cowan, C.L.; Walker, W.A. (General Electric Co., Santa Barbara, CA (USA)). 1 Oct 1979. 53p. NTIS, PC A04/MF A01.

Operation Snapper consisted of five shots at the Nevada Proving Grounds fired in the spring of 1952 immediately following the three shots which comprised Operation Tumbler. Part 1 of this report presents the measurement of neutron flux external to the bomb made in poor geometry as functions of distance and energy with threshold detectors and as functions of time in both poor and good geometries. Descriptions of equipment and techniques are given, and the results as applied to the determination of the yield and temperature are discussed. Part 2 of the report covers the external neutron measurements which were made on the remaining four Snapper shots. These measurements utilized threshold detectors; some of the gold detectors were shielded by cadmium and cadmium-indium sandwiches, and others were unshielded samples. Measurements were obtained of neutron nvt in poor geometry as functions of indium-resonance energy, and the neutron nvt.

11505 **(AD-B—951748) Operation Wigwam. Project 2.2. Radiochemical analysis of Wigwam debris.** (General Electric Co., Santa Barbara, CA (USA)). 1 Feb 1980. 11p. NTIS, PC A02/MF A01.

Radiochemical analyses have been performed on four seawater samples from Operation WIGWAM. The confining environment of the deep underwater explosion of this atomic weapon produced no unusual effects on relative yields of products, but it did appear to increase the efficiency of the burst. Fractionation of radioactive materials before collection did not seem to be serious.

11506 **(AD-B—951749) Operation teapot. Operational summary. Report for Feb-May 55.** Parsons, H.E. (General Electric Co., Santa Barbara, CA (USA)). 1 Oct 1979. 94p. NTIS, PC A05/MF A01.

This report presents a summary of the military participation in Operation TEAPOT, conducted at the Nevada Test Site during the period 15 February through 28 May 1955. The missions of the military representation within the test organization were: (1) to conduct a series of military effects experiments; (2) to coordinate a series of operational training projects; (3) to assist the AEC in the conduct of operation; and (4) to coordinate military activities not falling within the purview of the test organization.

11507 **(AD-B—951750) Operation Plumbbob. Project 6.2 measurement of the magnetic component of the electromagnetic field near a nuclear detonation. Report for May-Oct 57.** Haas, P.H.; Wimenitz, F.N.; Hoadley, J.C.; Wicklund, J.S. (General Electric Co., Santa Barbara, CA (USA)). 1 Feb 1980. 63p. NTIS, PC A04/MF A01.

This report presents the final results of one of the 46 projects comprising the military-effect programs of the Operation Plumbbob, which included 24 test detonations at the Nevada Test Site in 1957.

11508 **(AD-B—951751) Operation Plumbbob. Operational summary. Report for May-Oct 57.** (General Electric Co., Santa Barbara, CA (USA)). 1 Oct 1979. 70p. NTIS, PC A04/MF A01.

11509 **(AD-B—951753) Operation Plumbbob. Project 41.1a. Fireball studies. Report for May-Oct 57.** (General Electric Co., Santa Barbara, CA (USA)). 1 Oct 1979. 75p. NTIS, PC A04/MF A01.

Measurements of gamma-radiation flux versus time, time-integrated gamma-radiation flux, time-integrated neutron flux with energy-sensitive detectors, air pressure, time-integrated radiant energy, radiant-energy flux with some spectral response, and gaseous electrical conductivity in and near an atomic fireball are reported. These measurements were made in support of weapon vulnerability studies.

11510 **(AD-B—951764) Operation Snapper. Final report Apr-Jun 52.** Page, G.B. (General Electric Co., Santa Barbara, CA (USA)). 1 Oct 1979. 47p. NTIS, PC A03/MF A01.

11511 **(AD-B—951765) Operation Redwing - commander task group 7.3. Final report Mar-Aug 56.** Wellings, J.H. (General Electric Co., Santa Barbara, CA (USA)). 1 Oct 1979. 195p. NTIS, PC A09/MF A01.

Operation REDWING was conducted at the Pacific Proving Ground during the spring and summer of 1956. The main effort of the Navy task group (Task Group 7.3) was concentrated at Bikini Atoll in support of large yield shots. The broad mission of Task Group 7.3 was to provide the necessary naval support, including an evacuation capability, required by Joint Task Force Seven. Task Group 7.3 carried out the following assigned tasks: 1) conduct security and safety patrols (air and surface ship); 2) provide surface ship transportation between Eniwetok and Bikini and other atolls; 3) provide shipboard command, control and communications facilities for CJTF-7 and the task groups; 4) provide shipboard facilities to accommodate elements of the Joint Task Force while afloat, including pre-shot evacuations as directed by CJTF-7; and 5) provide support to scientific projects as requested.

4503 Explosion Detection

11512 **(AD-A—085879) Analysis of selected seismic events from Asia in a seismic discrimination context. Technical report.** Sobel, P.A.; von Seggern, D.H. (Teledyne Geotech, Alexandria, VA (USA). Seismic Data Lab.). 21 Sep 1978. 105p. NTIS, PC A06/MF A01.

This study examines earthquakes in Kamchatka, the Tien Shan, the Pamirs, the Baikal rift zone, and the Caucasus and explosions in the Aleutians, East Kazakh, West Kazakh, Southwest Russia, Lop Nor, and Baikal in a seismic discrimination context. Because of their low magnitudes (m sub b from 4.2 to 6.0 and M sub s from 3.2 to 5.8) and their varying propagation effects, it was impossible on the basis of first motions or LR amplitudes to determine source mechanisms for most of the earthquakes. Seismograms from the arrays ALPA, LASA, and NORSAR, the HGLP and the WWSSN stations were analyzed for m sub b, M sub s, corner frequency, long-period spectral level, long-period and short-period body-wave excitation, complexities, spectral ratios, radiation patterns, depth of focus, and higher-mode surface waves. The major successful discriminants for our data set were found to be M sub s-m sub b and identification of pP. In a stepwise linear discrimination analysis using the discrimination parameters M sub b, M sub s, corner frequency, complexity, spectral ratio, and long-period spectral level, the earthquakes were separated from the explosions with high confidence. In addition, some separation by region was evident for the earthquakes alone.

11513 **(AD-A—086802) Seismic data analysis center final report. Final technical report 1 Oct 76-30 Sep 77.** Blandford, R.R. (Teledyne Geotech, Alexandria, VA (USA). Seismic Data Lab.). 17 Jul 1978. 43p. NTIS, PC A03/MF A01.

The objectives of this work were to: (1) operate, program, and maintain real time and batch processors; (2) provide services to other government agencies and VELA participants; (3) conduct research in seismology; and (4) develop systems to control and process seismic information generated by remote stations in the Expanded VELA Seismic Network. Network development tasks included refining and developing the Detection Processing System (DPS) and completing efforts to make the Network Event Processor fully operational.

11514 **(AD-A—086840) Intersite magnitude-yield bias exemplified by the underground nuclear explosions MILROW, BOXCAR and HANDLEY. Technical report.** von Seggern, D.H. (Teledyne Geotech, Alexandria, VA (USA). Seismic Data Lab.). 5 May 1978. 67p. NTIS, PC A04/MF A01.

Estimates of surface-wave and body-wave magnitude were made from all available teleseismic WWSSN recordings of the

Nevada Test Site shots BOXCAR and the Amchitka Test Site shot MILROW, in the megaton range of yield. These shots had very closely matched medium properties at the shot point. Tectonic strain release is not a significant factor in the amplitudes of either set of waves for these two shots. When averaged over common networks, and corrected for slight yield difference, the BOXCAR m sub 6 is approximately 0.3 less than that of MILROW while the BOXCAR M sub s is approximately 0.5 larger than that of MILROW. Analysis of the respective shot media does not account for these differences. For m sub b the major portion of the difference is probably due to greater attenuation under the NTS, as evidenced by comparison of MILROW and BOXCAR waveshapes and spectra. No adequate explanation can be found for the large M sub s difference. Another megaton shot at NTS, HANDLEY, was also analyzed to provide control. While the HANDLEY m sub b is approximately equal to that of MILROW the shot point medium was substantially different and if account is made of the response of the shot point medium to a dilatant force according to the theory of Hudson and Douglas (1975), then the m sub b difference between HANDLEY and BOXCAR may be accounted for theoretically.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

11515 (PB—80-183064) Research highlights 1979. Annual report. Myers, D. (Delamer, Inc., Cupertino, CA (USA)). Jan 1980. 104p. NTIS, PC A06/MF A01.

The results described in this year's Highlights report represent but a few of the outputs supported by the Office of Research and Development in 1979. The Program ranges from direct support to EPA's regulatory functions, such as the developing of short-term tests for evaluating the toxicity of various substances and developing a classification method for hazardous wastes, to the publication of a new series of research documents to aid the public in learning about such research activities. This report covers studies on acid rain, the Chesapeake Bay, Energy (synthetic and conventional), radiation, clean air monitoring as well as municipal and industrial waste water.

5001 Basic Studies

11516 (ASCOT—80/5(Pt.1)) Modeling the nocturnal drainage flows. Rao, K.S.; Snodgrass, H.F. (National Oceanic and Atmospheric Administration, Oak Ridge, TN (USA). Atmospheric Turbulence and Diffusion Lab.). Dec 1979. Contract AI05-76EV03688. 55p. NTIS, PC A04/MF A01.

The evolution and structure of the steady state of an idealized nocturnal drainage flow over a large uniformly-sloping surface are studied using a nonstationary model with height-dependent eddy diffusivity profile and a specified cooling rate. The predicted mean velocity and temperature profiles are compared with Prandtl's stationary analytical solutions based on the assumption of a constant eddy diffusivity in the drainage layer. The effects of important physical parameters, such as the slope angle, surface cooling, atmospheric stability, and surface roughness, on the steady drainage flow are investigated. The extension of the model to account for the ambient winds and Coriolis effects is outlined, and its stationary analytical solutions are discussed.

11517 (CONF-8004110—) Carbon Dioxide Effects Research and Assessment Program: proceedings of the carbon dioxide and climate research program conference. Schmitt, L.E. (ed.). (Oak Ridge Associated Universities, Inc., TN (USA). Inst. for Energy Analysis). Dec 1980. Contract AC05-76OR00033. 295p. NTIS, PC A13/MF A01.

From DOE research conference on CO/sub 2/; Washington, DC, USA (24 Apr 1980).

Papers presented at the Carbon Dioxide and Climate Research Program Conference are included in this volume. Topics discussed are: the carbon cycle; modeling the carbon system; climatic response due to increased CO_2; climate modeling; the use of paleoclimatic data in understanding climate change; attitudes and implications of CO_2; social responses to the CO_2 problem; a scenario for atmospheric CO_2 to 2025; marine photosynthesis and the global carbon cycle; and the role of tropical forests in the carbon balance of the world. Separate abstracts of nine papers have been prepared for inclusion in the Energy Data Base. (RJC)

11518 (CONF-8004110—, pp 245-260) Marine photosynthesis and the global carbon cycle. Walsh, J.J. (Brookhaven National Lab., Upton, NY). Dec 1980.

From DOE research conference on CO/sub 2/; Washington, DC, USA (24 Apr 1980).

The role of the marine biota has been dismissed as insignificant in the global CO_2 cycle on the basis of nutrient limitation; this dismissal reflects the bias of oceanographers who study only the open ocean and the bias of marine biologists who study only intracellular metabolism. The CO_2 fixed each year during photosynthesis on the continental shelf and deposited as detrital particles on the adjacent continental slope may be a major organic sink of the global carbon cycle that is amenable to manipulation by man as a way of ameliorating the expected future CO_2 increases in the atmosphere. The role of photosynthesis in the global carbon cycle is discussed.

11519 (DOE/EV/12195—33) Climatic fluctuations, volcanic aerosol and carbon dioxide changes. Annual progress report, 1 October 1979-30 September 1980. Newell, R.E. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Meteorology). 21 May 1980. Contract AS02-76EV12195. 11p. NTIS, PC A02/MF A01.

Technical progress made for the contract period 1 October 1979-30 September 1980, and in fact since the last progress report was prepared on 18 June 1979, is summarized. The relationship between tropospheric air temperature, sea surface temperature patterns and volcanic aerosol has been derived by the application of generalized least squares analysis, which takes account of significant autocorrelation between the variables. Up to 50% of the variance of the tropical tropospheric air temperature can be explained in terms of preceding values of the variables. The technique is being applied to make a preliminary climatic forecast of the effect of the Mt. St. Helen's eruption of 18 May 1980 on zonal mean Northern Hemisphere temperature. A regression approach was used to forecast winter temperature over the continental US using parameters from our data base. Techniques for experimental climatic forecasting are being developed and studies of the background sea-air interaction processes are being made. We have shown that surface effects extend up to at least 500 mb in the atmosphere. Tropical rainfall has been found to vary with the Southern Oscillation Index; this rainfall provides the main energy supply to the atmosphere in the form of latent heat liberation.

11520 (PB—80-184575) User's guide to the ELSTAR stationary source emissions data preprocessor. Lurmann, F. (Environmental Research and Technology, Inc., Westlake Village, CA (USA)). Mar 1980. 129p. NTIS, PC A07/MF A01.

This report describes computer programs designed to preprocess stationary point source emissions data for the ELSTAR photochemical air quality simulation model. The ELSTAR model requires hydrocarbon, oxides of nitrogen, carbon monoxide, and oxides of sulfur emissions data for stationary point sources. The programs convert emissions data compiled in the U.S. EPA's Emissions Inventory Subsystem (EIS) format to the format required by the ELSTAR model. The conversion process includes assignment of source data to source categories, assignment of diurnal operating characteristics, assignment of hydrocarbon emission composition profiles (in six classes), and conversion of source locations to emission grid square indices. Major point sources are inventoried separately from minor point sources in the processing. This manual describes the general structure and operational capabilities of the programs. Detailed instructions are provided for the preparation of the input data.

11521 **(PB—80-188139) Development of the Elstar (Environmental Lagrangian Simulator of Transport and Atmospheric Reactions) photochemical air quality simulation model and its evaluation relative to the LARPP (Los Angeles Reactive Pollutant Program) data base.** Lloyd, A.C.; Lurmann, F.W.; Godden, D.G.; Hutchins, J.F.; Eschenroeder, A.Q. (Environmental Research and Technology, Inc., Westlake Village, CA (USA)). Sep 1979. 570p. NTIS, PC A24/MF A01.

This report covers the data analysis and model development work performed to create and validate ELSTAR (Environmental Lagrangian Simulator of Transport and Atmospheric Reactions), a photochemical trajectory model for the prediction of ozone and nitrogen dioxide concentrations. Data from the Los Angeles Reactive Pollutant Program (LARPP), an extensive field program initiated to provide a meteorological and air quality data base for trajectory model development, were used both in developing and testing ELSTAR. The LARPP data base was found to be ideal for the development of such a trajectory model. Included in the report is a description of the stepwise development and testing of the model, a discussion of the test results, recommendations for future field programs, a discussion of the model's limitations, and a recommended procedure to be followed in subsequent ELSTAR applications. A companion report, User's Guide to the ELSTAR Photochemical Air Quality Simulation Model, is available to provide user instruction for running the ELSTAR computer program.

11522 **(PB—80-811623) Atmospheric modeling of air pollution. 1977-78 (a bibliography with abstracts). Report for 1977-1978.** Carrigan, B. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 225p. NTIS PC N01/MF N01.

Lower atmospheric modeling of air pollution from both mobile and stationary sources are covered in the bibliography. Models cover local diffusion, urban heat islands, precipitation washout, worldwide diffusion, climatology, and smog. Stratospheric modeling concerning supersonic aircraft are excluded. (This updated bibliography contains 216 abstracts, none of which are new entries to the previous edition.)

11523 **(PB—80-811631) Atmospheric modeling of air pollution. 1979-May, 1980 (a bibliography with abstracts). Report for 1979-May 80.** Carrigan, B. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 139p. NTIS PC N01/MF N01.

Lower atmospheric modeling of air pollution from both mobile and stationary sources are covered in the bibliography. Models cover local diffusion, urban heat islands, precipitation washout, worldwide diffusion, climatology, and smog. Stratospheric modeling concerning supersonic aircraft are excluded. (This updated bibliography contains 130 abstracts, 88 of which are new entries to the previous edition.)

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 10111, 10163, 10167, 10178, 10241, 10272, 10276, 10277, 10278, 10280, 10281, 10429, 10861, 10863, 11306, 11517, 11664, 11678, 11681, 11685

11524 **(AD-A—086786) The 1979 NRL air quality data. Annual report.** Stamulis, A. (Naval Research Lab., Washington, DC (USA)). 16 May 1980. 40p. NTIS, PC A03/MF A01.

This report is a summary of the air quality data measured and recorded during the calendar year 1979. This annual summary is part of a continuing series initiated in 1975. The variables summarized include ozone (O3), sulfur dioxide (SO2), nitric oxide (NO), nitrogen dioxide (NO2), total hydrocarbons (THC), methane (CH4), non-methane hydrocarbons (RHC), carbon monoxide (CO), air temperature, relative humidity, wind direction, and wind speed. The instruments in use at the NRL air monitoring station are interfaced to a data acquisition system which in turn is coupled to a magnetic tape recorder. The data input is for one month on a tape which is subsequently analyzed by the NRL air computer program and results in a monthly computer printout of the essential air quality data. Each of the monthly computer printouts is then analyzed and a digest of the information obtained is reported as the annual summary. Included in the report is some background information thought necessary in understanding the data. Finally, a brief description of the odor nuisance problem at NRL is described.

11525 **(AD-A—087264) Atmospheric marine boundary layer mixing rates in the California coastal region. Technical report.** Schacher, G.E.; Fairall, C.W.; Davidson, K.L. (Naval Postgraduate School, Monterey, CA (USA)). May 1980. 124p. NTIS, MF A01.

The Naval Postgraduate School has conducted five research cruises in California coastal waters for which sufficient data was obtained to allow boundary layer mixing rates to be determined. These data have been processed to determine the mixing rates. The rates have been correlated with meteorological conditions and geographical location and average values for use in air pollution models have been determined. A simplified method for calculating the mixing rate from mean meteorological parameters is presented.

11526 (CONF-800334—(Vol.1), pp 229-244) **Characterization of effluents from an experimental atmospheric pressure fluidized bed combustor.** Hobbs, C.H. (Inhalation Toxicology Research Inst., Albuquerque, NM); Carpenter, R.L.; Newton, G.J.; Kovach, J.J.; Hanson, R.L.; Weissman, S.H.; Clark, C.R.; Hill, J.O.; Shang, J.Y. Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

Over the past three years the Inhalation Toxicology Research Institute (ITRI) and the Morgantown Energy Technology Center (METC) have been engaged in a collaborative research effort to characterize the potential emissions from the atmospheric pressure fluidized bed combustion (AFBC) of coal. The primary purpose of the research is to determine the potential health risks to man from increased use of this technology. The purpose of this report is to summarize the currently available data from the physicochemical characterization and the toxicological testing of samples that have been obtained from the 18-inch AFBC at METC while it was burning several coal types and operating under various conditions. Based on our studies of the potential emissions of AFBC and comparing them to data available in the literature from PCC, the following conclusions have been made: AFBC particle emissions are comparable or lower than from conventional power plants; AFBC trace element emissions are comparable or lower than conventional power plant emissions; AFBC polycyclic organic emissions appear to be higher than estimated for conventional power plants and are primarily vapor phase as measured; mutagenic activity has not been detected in AFBC vapor phase polycyclic organic AFBC samples tested to data; mutagenic activity has been detected in some fly ash samples from the AFBC bag filter and stack; and the mutagenic activity per mass of fly ash extracted appears to be less in the METC fluidized bed combustor ash than that reported for one conventional power plant.

11527 (CONF-800334—(Vol.1), pp 245-268) **Preliminary operation and environmental characterization of the Georgetown University fluidized bed combustor.** Treado, P.A.; Shaff, D.P. (Georgetown Univ., Washington, DC). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

Georgetown University and Fluidized Combustion Company have completed the construction of an atmospheric-pressure fluidized bed combustion (AFBC) system which is burning high sulfur coal in an environmentally acceptable manner. Due to a low steam demand by the University campus, much of the operation has been restricted such that only one bed has been ignited and producing steam. The emissions monitoring system has been functioning both prior to and during the operation. Some reasonable correlations have been made between the sulfur content of the coal being burned, the amount of limestone injected into the bed and the effluent SO_2 and O_2 content of the stack emissions. The following emissions from the stack have been measured: SO_2, O_2, NO/NO/sub x/, CO, CO_2, opacity, particulates and hydrocarbons including polycyclic aromatic hydrocarbons. The particulate analysis has included POMs, TSP and elemental analysis. The emissions sampling and analysis systems include: continuous chemiluminescence NO/NO/sub x/, NDIR CO and CO_2, paramagnetic O_2, pulsed uv fluorescence SO_2 and double-pass optical transmissometer opacity moni-

tors; as well as offline flame ionization and GC hydrocarbon monitors and proton induced x-ray, mass spectrometer, and optical emissions spectrometer elemental analysis apparatus. This paper is a status report of the preliminary operation and environmental characterization of the Georgetown AFBC with particular emphasis on data obtained from one of the two beds in operation for over 1000 hours. In addition, the specific problems addressed in the attempts to maximize the on-time for the emissions monitoring apparatus will be discussed.

11528 (CONF-800334—(Vol.1), pp 335-352) **Emissions control for coal-fired MHD systems.** Lanier, J.H.; Attig, R.C.; Kulesza, P.R. (Univ. of Tennessee Space Institute, Tullahoma). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

Rising fossil fuel prices and fuel shortages in the last few years have led to an increased effort to develop magnetohydrodynamics (MHD) for electrical power generation. Much has already been said in the literature about the efficiency potential of MHD cycles and numerous papers have described MHD combustor and generator work and related development efforts. Interest in the bottoming cycle and pollution control has increased recently. However, except for the USSR development of a gas-fired MHD Electrical Power System there is little experimental data available on the down-stream components or pollution control. This paper will describe work sponsored by the Department of Energy and carried out at UTSI to develop an understanding of pollution control aspects while operating coal-fired MHD systems. Recent work at UTSI involved the design, fabrication and erection of a secondary combustor to burn the combustibles remaining in the gas stream, and to do so in a manner that minimizes nitrogen oxide formation. This paper will describe that apparatus, and the results of nitrogen oxide and sulfur dioxide measurements made during the ensuing test program.

11529 (CONF-800334—(Vol.1), pp 353-374) **Measurement and control of fugitive hydrocarbon emissions.** Mesich, F.G.; Dzierlenga, P.S. (Radian Corp., McLean, VA). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The control of fugitive emissions has received significant attention over the past several years. Until recently, the prevailing attitudes were that existing maintenance programs were effective in preventing leaks. This has largely been true from the standpoint of explosion hazard but, as the results of the three year refinery study show, not necessarily true from the standpoint of preventing significant hydrocarbon emissions. The crude estimates made in this paper for an EDS plant indicate that essentially all of the hydrocarbon emissions will result from leaks. It has not been possible to eliminate leaks from petroleum refineries but directed screening and maintenance programs can potentially reduce leaks by over 50 percent, and even more in critical leak areas. Equipment design, selection and maintenance are the keys to reducing leaks when coupled to a rapid, efficient detection and measurement program. With suitable modification in instrumentation or procedures, the leak reduction methodology developed for the petroleum refining industry should be readily adaptable to the new synfuels industry. In fact, including fugitive emission control as a design consideration in the new plants should provide even more effective and economically less burdensome leak control than that possible in a refinery which was built some years ago with controls now being superimposed on an existing system.

11530 (CONF-800334—(Vol.2), pp 627-649) **Automotive particulate emissions.** Duleep, K.G.; Dulla, R.G. (Energy and Environmental Analysis, Arlington, VA). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

This paper analyzes current particulate measurement techniques and the adaptabiity of these techniques to the measurement of particulate emissions from turbine engines. The particulate formation process is briefly described and a general methodology to measure combustion particulate emissions is outlined. This is done to explain the rationale of the EPA Recommended Procedure for particulate sampling from automobiles. The EPA Procedure is reviewed and the differences possible in the implementation of this procedure are identified. The differences, or uncontrolled parameters, are examined for their effects on measured particulate emissions. The EPA Recommended Procedure's adaptability to measuring particulates from the gas turbine engine is examined. The effects of the uncontrolled parameters in relation to the gas turbine's exhaust are analyzed and specific recommendations for the control of these parameters to improve the accuracy of particulate emission measurement are made.

11531 (CONF-800869—5) **Stratospheric ozone in the planetary boundary layer.** Dutkiewicz, V.A.; Husain, L.; Rusheed, A. (New York State Dept. of Health, Albany (USA). Div. of Labs. and Research (USA)). 1980. Contract AS02-77EV04501. 8p. NTIS, PC A02/MF A01.

From Quadrennial international ozone symposium; Boulder, CO, USA (4 Aug 1980).

The impact of stratospheric ozone associated with rapid transport processes at remote Whiteface Mountain, New York was studied using ^{7}Be as a stratospheric tracer. The seasonal variation of ^{7}Be concentration suggests that the greatest impact of stratospheric ozone at Whiteface Mountain occurs during late spring and early summer consistent with the time when the impact of tropopause folding should be maximum. This is also the time when tropospheric photochemical ozone production is likely to be maximum. The analysis of 33 cases with peak $^{7}Be > 175$ fCi/m^{3} shows strong correlation between averaged O_3 and ^{7}Be concentration. Assuming peak ^{7}Be is associated with rapid transport we estimate 12 ppbv as the 24th average increased O_3 due to tropopause folding events. Also the average SO_4^{2-} concentration peaked a day after ^{7}Be suggesting the backside of the weather system responsible for rapid subsidence also favors transport to this site from distant urban-industrial centers. Thus, photochemical pollution episodes may be intensified by stratospheric subsidence.

11532 (DOE/EV/02986—1) **Wet deposition in the northeastern United States.** Wilson, J.; Mohnen, V.; Kadlecek, J. (State Univ. of New York, Albany (USA). Atmospheric Sciences Research Center). Dec 1980. Contract AS02-76EV02986. 143p. NTIS, PC A07/MF A01.

Attempts are made to examine concentration and wet deposition of pollutant material at selected stations within the northeastern United States and to characterize as many events as possible with respect to air mass origin. Further attempts are made to develop a regional pattern for the deposition of dominant ion species. MAP3S (US Multistate Atmospheric Power Production Pollution Study) data for 1977 to 1979 are used to determine concentration and deposition on an event basis from which monthly, seasonal, annual, and cumulative averages are developed. The ARL-ATAD trajectory model is used to characterize individual events as to air mass origin. Case studies are examined to illustrate variability in the chemical composition of precipitation originating from distinctly different air mass trajectories. A difference in concentration of pollution-related ions in precipitation is noted between Midwest/Ohio Valley and Great Lakes/Canadian air mass origins for carefully selected cases. Total deposition of the major ions is examined in an effort to develop a regional pattern for deposition over a period of at least one year. For that purpose, total deposition is normalized to remove the variability in precipitation amounts for inter-station comparison. No marked gradient is noted in the normalized deposition totals within the northeast of the United States. The Adirondack region exhibited the lowest normalized ion deposition value, while the Illinois station showed the highest of the MAP3S network. The data analysis suggest that the acid rain phenomena covers the entire northeast. The concept of large scale mixing emerges to account for the lack of a significant gradient in the normalized deposition.

11533 (DOE/EV/04958—T1) **Final report on measurement of surface fluxes of air pollutants.** Stedman, D.H. (Michigan Univ., Ann Arbor (USA)). Jan 1981. Contract AS02-78EV04958. 96p. NTIS, PC A05/MF A01.

Research progress is reported on the design, construction, and delivery of appropriate air pollutant detectors. The pollutants studied included ozone, nitrogen oxides, and sulfur species.

11534 (DOE/OR/03054—T3, pp 42-54) **Review of current assessments of the CO_2 greenhouse effect.** Firley, J.A. (International Coal Refining Co., Allentown, PA). 1980.

In SRC-1 solvent-refined coal. Quarterly technical report, January-March 1980.

Present climate models predict that, given the projected atmospheric carbon dioxide increases from fossil fuel combustion, the average global temperature will rise 1.5 to 3.0°C near the year 2030. The consequences of this global warming are unknown; they may or may not be favorable. The projected effects which have a negative environmental impact include: (1) dislocation of major agricultural regions due to changing climate and rainfall; (2) partial melting of the polar ice caps causing 5- to 6-meter rise in sea level; and (3) massive extinction of plant and animal species due to rapid climate change. On the other hand, the positive environmental impacts include: (1) longer growing seasons, resulting in increased food productivity; and (2) an increase in habitable and food-producing land in the higher latitudes. Not only are the consequences of a given 1.5 to 3.0°C of global warming debatable, the quantitative degree of warming which may be caused by increasing CO_2 is uncertain. Predictions range from a 1.5 to a 4.5°C increase with a doubling of CO_2 levels. In addition to these uncertainties, the amount of CO_2 which will accumulate in the atmosphere due to a given amount of fossil fuel combustion cannot be predicted accurately. These issues may be resolved as we gain an increased understanding of the climate, the carbon cycle, and the mechanisms and interactions of the carbon reservoirs.

11535 **Compound forms of fossil fuel fly ash emissions.** Henry, W.M.; Knapp, K.T. (Battelle Columbus Labs, Ohio;EPA, NC). *Environmental Science and Technology* ; **14**: No. 4, 450-456(Apr 1980).

A methodology for determining inorganic compounds present in particulate emissions from fossil fuel combustion processes is described. Samples collected from power plants burning oil and coal fuels of different composition provided a typical range of flyashes for the investigation. X-ray diffraction, Fourier transform infrared, and chemical-phase analyses were performed to determine elemental compositions of samples. Water-soluble sulfates are the predominant species present in oil-fired particulate emissions. (2 photos, 7 references, 9 tables)

11536 **(LA—8610-MS) Oxidation of depleted uranium penetrators and aerosol dispersal at high temperatures.** Elder, J.C.; Tinkle, M.C. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 53p. NTIS, PC A04/MF A01.

Aerosols dispersed from depleted uranium penetrators exposed to air and air-CO_2 mixtures at temperatures ranging from 500 to 1000°C for 2- or 4-h periods were characterized. These experiments indicated dispersal of low concentrations of aerosols in the respirable size range [typically $<10^{-3}$% of penetrator mass at 223 cm/s (5 mph) windspeed]. Oxidation was maximum at 700°C in air and 800°C in 50% air-50% CO_2, indicating some self-protection developed at higher temperatures. No evidence of self-sustained burning was observed, although complete oxidation can be expected in fires significantly exceeding 4 h, the longest exposure of this series. An outdoor burning experiment using 10 batches of pine wood and paper packing material as fuel caused the highest oxidation rate, probably accelerated by disruption of the oxide layer accompanying broad temperature fluctuation as each fuel batch was added.

11537 **(LA—8667-MS) Horizontal diffusion in the atmosphere: a Lagrangian-dynamical theory.** Gifford, F.A. (Los Alamos Scientific Lab., NM (USA)). Jan 1981. Contract W-7405-ENG-36. 20p. NTIS, PC A02/MF A01.

A form of Langevin's equation is derived that is applicable to the atmospheric diffusion problem. The resulting equation for the particle displacement variance has limits at small and large diffusion times equal to asymptotic predictions of statistical diffusion theories but provides, in addition, estimates over the broad, middle range of diffusion, which is important in regional and larger-scale atmospheric applications. Predictions of the theory compare well with standard atmospheric diffusion data sets over a range of diffusion times, from second to days. When parameters of the theory are determined from short-range plume diffusion data, the theory predicts large-scale eddy diffusivity, K, in the known atmospheric range, a striking confirmation of the ability of this theory to describe atmospheric diffusion.

11538 **(PB—80-182439) APTI (Air Pollution Training Institute) course 450 source sampling for particulate pollutants. Student workbook.** (Northrop Services, Inc., Research Triangle Park, NC (USA)). Dec 1979. 166p. NTIS, PC A08/MF A01.

This workbook is used in conjunction with Course No. 450, 'Source Sampling for Particulate Pollutants', as designed and presented by the EPA Air Pollution Training Institute (APTI). The workbook includes course objectives, lecture aides, calculation problems, and instructions for the course laboratory exercises. Tables of nomenclature, source sampling forms, and representations of selected course visual materials are given to aide the student in his understanding of EPA Federal reference method 5 for sampling particulate matter from stationary sources. The workbook is not meant to stand on its own, but is to be used with the course manual, EPA-450/2-79-006 during the lecture and laboratory sessions of the training course. An instructor's manual (EPA 450/2-80-003) entitled 'Source Sampling for Particulate Pollutants' is also available for use in presenting the training course.

11539 **(PB—80-182603) University of Washington electrostatic scrubber tests: combined particulate and SO_2 control. Final report Jun 78-Aug 79.** Pilat, M.J. (Washington Univ., Seattle (USA). Dept. of Civil Engineering). Nov 1979. 62p. NTIS, PC A04/MF A01.

The report gives results of tests of a 1700 a cu m/hr University of Washington electrostatic spray scrubber pilot plant on a coal-fired boiler to demonstrate its effectiveness for controlling fine particle and SO2 emissions. The multiple-pass portable pilot plant operates by combining oppositely charged aerosol particles and water droplets in two spray towers. Aerosol charging sections at a negative polarity precede each spray tower. For these tests, the pilot plant used only one charging section and one spray tower. A liquor recycle system was constructed, permitting the pilot plant to operate in an open- or closed-loop mode. All SO2 tests were run in an open-loop mode using either water or Na2CO3 solution as the scrubbing liquor. Simultaneous inlet and outlet source tests using cascade impactors provided size-dependent and overall mass basis particle collection efficiency data. Measured over-all particle collection efficiencies were 98.99%-99.80%, depending on scrubbing operating conditions. SO2 collection efficiencies were 8.02%-97.41%, depending on the scrubber operating conditions, inlet SO2 concentration, and the type of scrubbing liquor used.

11540 **(PB—80-182942) Inventory of emissions from nonautomotive vehicular sources. Final report.** Taback, H.J.; Macko, J.F.; Parker, N.R.; Dale, D.A.; Erlich, S. (KVB, Inc., Irvine, CA (USA). Research and Analysis Div.). Feb 1980. 224p. NTIS, PC A10/MF A01.

The report presents the results of a program to develop methodologies for the inventory of emissions from nonautomotive vehicular sources, which are applicable in all areas of California; and using these methods, compile an inventory of emissions for 1977 for the four counties comprising the South Coast Air Basin. In this study, nonautomotive vehicular sources were defined as construction equipment, farm vehicles, industrial vehicles, and small boats. The general approach was to determine total annual fuel consumption by vehicle type, then multiply each total by the appropriate EPA emission factors. For construction equipment, the method is based upon the level of construction activity, miles of roadway constructed, and human population. For farm vehicles, the method is based upon the annual number of harvested acres of each type of crop. For industrial vehicles, the method is based upon the vehicle population and usage factors. Boats are separated into pleasure and commercial categories, with usage and fuel consumption factors for each group.

11541 **(PB—80-183353) State-of-the-art of sampling and analysis for diesel exhaust contaminants. Open file report (Final), 29 Sep 78-29 Jul 79.** Menzies, K.T.; Levins, P.L.; Broome, M.G.; Fanucci, M.H. (Little (Arthur D.), Inc., Cambridge, MA (USA)). 30 Jul 1979. 174p. NTIS, PC A08/MF A01.

Over 1,500 literature citations related to diesel exhaust sampling and analysis were obtained as a result of computer and manual searches of 9 data bases. Abstracts and hard copies of relevant citations were reviewed and those considered appropriate for evaluation were included in a bibliography. Based on the literature collected, available sampling and analysis methods for the following diesel exhaust contaminants were evaluated: CO, CO2, NO, NO2, hydrocarbons, particulates, PNA, SO4, and oxygenates. Emphasis was given to laboratory and field methods for these species. Methods were evaluated on the basis of sensitivity, selectivity, accuracy, and reliability and a selected list of preferred methods was developed for each compound class. The selected methods were additionally evaluated through communication with current investigators. Sampling and analysis methods for all compounds except CO and CO2 showed some unreliability. Recommendations were made for future research to develop, improve, and validate methods.

11542 **(PB—80-183866) Performance of a high-velocity pulse-jet filter, II. Final report Sep 76-Sep 79.** Leith, D.; Ellenbecker, M.J.; First, M.W.; Price, J.M.; Martin, A. (Harvard Univ., Boston, MA (USA). School of Public Health). Mar 1980. 75p. NTIS, PC A04/MF A01.

The report gives results of a study of the performance of a high-velocity pulse-jet filter. Such filtration has distinct advantages over low-velocity filtration in that the equipment required to clean a gas stream is reduced in size and initial cost as velocity increases. Although high filtration velocity causes a number of problems, many of them are dealt with in the report. Location of the gas inlet to the filter was found to affect penetration and pressure drop; both were higher for inlets near the bottom of the filter housing. Fabric type was also found to affect performance by affecting the amount and characteristics of the dust deposit accumulated. Fabric surface properties help explain the nature of this deposit. These ideas and others were used to develop a mathematical model for pressure drop in a pulse-jet cleaned filter. The model can be used to predict pressure drop under stable or variable operating conditions, and to predict operating conditions that cause unstable filter operation. An understanding of particle/fiber interactions is essential to understanding the collection characteristics of a felt fabric. Under certain conditions, particles bounce on impact with fibers. An adhesion probability was determined and found to depend on incident particle kinetic energy.

11543 **(PB—80-184021) Program of research and monitoring for early detection of stratospheric ozone change. Report to congress of findings for 1978-1979.** (National Oceanic and Atmospheric Administration, Washington, DC (USA)). Jan 1980. 47p. NTIS, PC A03/MF A01.

Section 126, on 'Ozone Protection,' of P.L. 95-95, the 'Clean Air Act Amendments of 1977,' requires that the National Oceanic and Atmospheric Administration shall establish a continuing program of research and monitoring of the stratosphere for the purpose of early detection of changes in the stratosphere and climatic effects of such changes. Findings for the period 1978-1979 of the research and monitoring activities of the NOAA centers--The Aeronomy Laboratory, the Air Resources Laboratories, the Geophysical and Fluid Dynamics Laboratory, the Office of Research of the National Environmental Satellite Service, the Climate Analysis Center of the National Weather Service, and the Satellite Data Service Division of the Environmental Data and Information Service's National Climatic Center--are presented. The findings from NOAA's stratospheric research and monitoring program are applicable to issues of national concern in three broad areas: measurements from the worldwide ozone monitoring network, other measurements of significant stratospheric parameters and model calculations of stratospheric ozone behavior under continued chlorofluorocarbon release.

11544 **(PB—80-184922) Relationship between specific non-methane hydrocarbons and ozone in ambient air and their role in transportation control strategies. Final report Jul 77-Oct 78.** Altwicker, E.R.; DiCesare, F. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Chemical and Environmental Engineering). Sep 1979. 139p. NTIS, PC A07/MF A01.

Specific non-methane hydrocarbon concentrations in ambient air have been measured in two urban regions: New York City and the Albany/Troy/Schenectady TriCity area. In each region two elevated sites were also used. This report contains quantitative data on twenty compounds; a total of forty three hydrocarbons were identified via gas chromatography. Sampling periods and schedules are given. Information on ozone concentrations was obtained simultaneously or gathered from cooperating agencies. A series of studies were conducted to investigate stability of ambient hydrocarbons in plastic bags. Some of the ambient sampling results were coupled with emission inventory information to generate a hydrocarbon source reconciliation to relate automotive and stationary source emissions to ambient air quality. Models that relate hydrocarbons and nitric oxide to ozone formation were reviewed in order to evaluate how best to utilize the ambient air quality information obtained above and how to assess its impact on transportation control strategies.

11545 **(PB—80-187990) Photochemical aerosol formation: reactive hydrocarbon-NOx-SO_2 systems. Final report.** Fox, D.L.; Jeffries, H.E.; Feigley, C.E. (North Carolina Univ., Chapel Hill (USA). Dept. of Environmental Sciences and Engineering). Dec 1979. 157p. NTIS, PC A08/MF A01.

The results of an investigation of photochemical aerosol formation by 1-hexene, 1,7-octadiene, cyclohexene, cyclopentene, and toluene are reported. The experiments were conducted in the University of North Carolina (UNC) outdoor aerosol chamber utilizing natural sunlight to activate the photochemical reactions in systems containing a single hydrocarbon, nitric oxide (NO), and nitrogen oxide (NO2). The effect of sulfur dioxide (SO2) on these systems was also determined. The chamber was operated as a batch chemical reactor with injections of the reactants made before sunrise, and the chemical and physical transformations were measured until approximately 1500 EDT. Initial conditions were selected to insure photochemical aerosol formation. This program is the first time aerosol formation from these compounds has been investigated under ambient conditions of temperature and solar radiation. The aerosol formation behavior of single hydrocarbons and mixtures with SO2 was investigated with instrumentation yielding size distribution formation.

11546 **(PB—80-811565) Precipitation washout. 1964-June, 1980 (a bibliography with abstracts). Report for 1964-Jun 80.** Brown, R.J. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 162p. NTIS PC N01/MF N01.

The reports cited in the bibliography cover the removal of pollutants, radioactive isotopes, and dust by rain and snow. The theory, modelling, sampling and effects of precipitation washout are presented. (This updated bibliography contains 154 abstracts, 6 of which are new entries to the previous edition.)

11547 **(PB—80-812266) Sulfur dioxide control, 1977-1978 (citations from the NTIS data base). Report for 1977-78.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 237p. NTIS PC N01/MF N01.

Report citations cover air pollution control technology and equipment for sulfur dioxide. References are included on emissions reduction, involving fluidized bed combustion, combustion modification and additives, scrubbing, and other flue gas desulfurization processes. Fuel desulfurization and the use of low sulfur fuels are excluded. (This updated bibliography contains 230 abstracts, none of which are new entries to the previous edition.)

11548 **(PB—80-812274) Sulfur dioxide control, 1979-June, 1980 (citations from the NTIS data base). Report for 1979-Jun 80.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 181p. NTIS PC N01/MF N01.

Report citations cover air pollution control technology and equipment for sulfur dioxide. References are included on emissions reduction, involving fluidized bed combustion, combustion modification and additives, scrubbing, and other flue gas desulfurization processes. Fuel desulfurization and the use of low sulfur fuels are excluded. (This updated bibliography contains 160 abstracts, 111 of which are new entries to the previous edition.)

11549 **(UCID—18878) ASCOT FY-1980 progress report.** Dickerson, M.H.; Gudiksen, P.H. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Nov 1980. Contract W-7405-ENG-48. 19p. (ASCOT—80-10). NTIS, PC A02/MF A01.

An overview of the accomplishments of the DOE Atmospheric Studies in Complex Terrain (ASCOT) program during FY-1980 is presented. Fiscal Year 1980 was the second in a three to four year ASCOT study being conducted in The Geysers area of Northern California to achieve the following objectives: to augment the present knowledge of the physical mechanisms involved in the development, perpetuation, and breakup of nocturnal drainage flows; to develop an integrated measurement and modeling methodology to perform air quality impact assessment and control strategies for energy development in areas subject to drainage flows; and to provide the developed methodology with special applications to the H_2S emissions associated with The Geysers geothermal development. This year the focus of the work was on the major areas of reducing, analyzing and modeling data taken during the July 1979 field experiment within the Anderson Creek Valley at The Geysers and planning and executing a major field experiment in September 1980.

11550 **(UCID—18924) Relative efficiency of a number of halocarbons for destroying stratospheric ozone.** Wuebbles, D.J. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Jan 1981. Contract W-7405-ENG-48. 12p. NTIS, PC A02/MF A01.

Existing theoretical calculations and atmospheric measurements have indicated that the halocarbons $CFCl_3$ and CF_2Cl_2 have sufficiently long atmospheric lifetimes that, although they are produced and released into the atmosphere at the surface, they are primarily decomposed in the stratosphere photochemical processes. The chlorine atoms relesed by this decomposition process can participate in chlorine catalytic mechanisms for destroying stratospheric ozone. The possible depletion of the stratospheric ozone layer by such sources could have significant biological and agricultural impacts because of the sensitivity of living organisms to the increased ultraviolet irradiation that would accompany a decrease in the stratospheric ozone shield. This study uses the LLNL one-dimensional transport-kinetics model of the troposphere and stratosphere to examine the relative efficiency of a number of compounds for potentially reducing stratospheric ozone concentrations.

11551 **Variations in the ambient ozone concentration during the 26 February 1979 solar eclipse.** Eastman, J.A. (Argonne National Lab., IL); Stedman, D.H. *Atmospheric Environment ;* **14**: 731-732(1980).

The ambient ozone concentration was measured during the partial solar eclipse on 26 February 1979, at Argonne National Laboratory. A 50% reduction in the ozone concentration occurred during the eclipse as a result of photochemical reactions. The observed lag time between the minima of the solar radiation and the ozone concentration is consistent with the computed lag time. The labile nature of ozone is self-evident in what may be the first measurement of the ambient ozone concentration during a solar eclipse.

11552 **Some analytical aspects of the quantitative determination of polynuclear aromatic hydrocarbons in fugitive emissions from coal liquefaction processes.** White, C.M. (Dept. of Energy, Pittsburgh, PA); Sharkey, A.G. Jr.; Lee, M.L.; Vassilaros, D.L. pp 261-275 of Polynuclear aromatic hydrocarbons. Jones, P.W.; Leber, P. (eds.). Ann Arbor, MI; Ann Arbor Science Publishers Inc. (1979).

From 3. symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (Oct 1978).

The objective of this study is to develop a method for the quantitative collection and analysis of PAH in fugitive emissions in the ambient air of coal liquefaction plants. The investigation is divided into three distinct areas: (1) sample collection; (2) sample separation and purification of a PAH-rich fraction; and (3) identification and quantitation of individual PAH. This report describes the results of a investigation of the collection efficiency of Tenax-GC for PAH, the recovery of PAH from Tenax-GC via solvent extraction, and the development of a new gas chromatographic retention index system unique for PAH. The applicability of the PAH retention index system is demonstrated by the analysis of a coal liquefaction product.

11553 **Measurement of polynuclear aromatic hydrocarbons and other hazardous organic compounds in stack gases.** Bennett, R.L. (Environmental Protection Agency, Research Triangle Park, NC); Knapp, K.T.; Jones, P.W.; Wilkinson, J.E.; Strup, P.E. pp 419-428 of Polynuclear aromatic hydrocarbons. Jones, P.W.; Leber, P. (eds.). Ann Arbor, MI; Ann Arbor Science Publishers Inc. (1979).

From 3. symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (Oct 1978).

Because of the growing concern of the dangers from hazardous organic air pollutants, EPA has continued to sponsor projects for the development of measurement methods and for the characterization of organic emissions from stationary sources. Several sampling systems which use macroreticular resin adsorption beds to collect the emitted organic compounds are described. Concentrations of PAH collected at an oil-fired power plant varied from over 2000 to only 23 ng/Nm^3. The sample with the high concentration contained only the lower-molecular-weight PAH; none were found above the detection limit with a molecular weight greater than 220. Several coal-fired power plants were sampled, and the range of concentrations found was from 24 to 378 ng/Nm^3. The concentration found in the samples from a secondary lead smelter was greater than 1000 ng/Nm^3, generally about four times that of the coal-fired power plants.

5003 Radioactive Materials Monitoring And Transport

11554 **(RFP—3168) Dose limitation practices in recovery operations involving prior environmental releases of plutonium.** Hornbacher, D.D.; Barker, C.J.; Crites, T.R. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1981. Contract AC04-76DP03533. 4p. NTIS, PC A02/MF A01.

Procedures used for cleanup of Pu-contaminated areas surrounding the Rocky Flats Plant are described. The net effect of the removal of soil for this project was estimated to reduce the annual airborne source term from resuspension of onsite soil 7 percent, a 70-year population dose commitment savings of around 1900 man-rem. Thus a cost of $240/man-rem averted was realized, a value at the high end of those suggested in ICRP 22. As experience was gained, environmental criteria and controls were developed which demonstrated that a wide variety of cleanup activities could be conducted in an environmentally sound manner. Governmental and public acceptance required demonstrations of new techniques, news media briefings, and a positive approach to disseminating information. Currently, this process is continuing as a joint monthly public meeting between Rocky Flats plant personnel and personnel from the Colorado Department of Health.

5005 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 10481, 11201

11555 **(PB—80-185200) The 1978 Denver winter haze study. Volume I. Executive summary. Final report.** Heisler, S.L.; Henry, R.C.; Watson, J.G.; Hidy, G.M. (Environmental Research and Technology, Inc., Westlake Village, CA (USA)). Mar 1980. 19p. NTIS, PC A02/MF A01.

A study of the nature and sources of the Denver winter haze was conducted over a 31-day period in November and December, 1978. Measurements were made of (1) optical properties of the air, (2) physical and chemical properties of suspended particles as a function of size, (3) the important pollutant gases (carbon monoxide, sulfur dioxide, nitrogen oxides, ozone and hydrocarbon vapors), and (4) meteorological parameters including winds, temperature, relative humidity and solar radiation. Elemental carbon was found to be the most important contributor (38%) to the particle light extinction coefficient. On the average, diesel emissions, natural gas combustion, coal combustion and unidentified sources of elemental carbon each contributed 12 to 15% of the particle extinction coefficient. Noncatalyst-equipped automobiles and unidentified sources of organic carbon each contributed 9 to 10%. Water, resid-

ual oil combustion and catalyst-equipped automobiles contributed about 4% each.

11556 (PB—80-186612) Futher investigation of air quality in the Lake Tahoe Basin. Barone, J.B.; Ashbaugh, L.L.; Eldred, R.A.; Cahill, T.A. (California Univ., Davis (USA). Crocker Nuclear Lab.). 27 Mar 1979. 82p. NTIS, PC A05/MF A01.

This study was designed to determine the air quality in the Lake Tahoe air basin. The study plan included the following data gathering components: (1) weekly particulate aerosol monitoring and daily intensive sampling of particulate aerosols in both summer and winter; (2) routine airplane over-flights and pilot balloon releases to provide meteorological data; (3) traffic volume counts to determine the traffic flow conditions in the basin; (4) review of emission inventory data for SO2 in the basin.

11557 (PB—80-187545) Environmental assessment of iron casting. Final report Mar 77-Mar 79. Baldwin, V.H. Jr. (Research Triangle Inst., Research Triangle Park, NC (USA)). Jan 1980. 171p. NTIS, PC A08/MF A01.

Sampling of ductile iron casting in green sand molds with phenolic isocyanate cores and in phenol-formaldehyde bound shell molds did not provide definitive proof that environmentally hazardous organic emission occur. Both molding systems produced the same type of major emissions, alkyl halides, carboxylic acid derivatives, amines, substituted benzenes, nitrogen heterocyclics, and fused aromatics in quantities that slightly exceed the lowest Minimum Acute Toxicity Effluent (MATE) values for the categories, but probably not for individual compounds. GC-MS analysis revealed the major fused aromatics to be naphthalene compounds. Quantitative analysis of specific PNA's showed no significant level of concern. Inorganic dust emissions are hazardous if uncontrolled because of silicon, chromium, and nickel. The dust is sufficiently high in 12 metals to render it a hazardous waste if collected as a sludge and landfilled, but leachate testing may change that categorization. Relatively high levels of Sr, Ba, Ce, Pr, and Nd in the dust indicate that inoculation smoke should be examined.

5006 Regulations

11558 (CONF-800334—(Vol.1), pp 313-334) **Environmental control requirements of the DOE Central Power Systems which utilize coal derived fuels.** Crim, W.M.; Manning, G.B. Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

A discussion of the environmental control requirements of advanced DOE central power systems is presented. EPA Standards of performance for New Stationary Sources will have to be met. This regulation limits emission of nitrogen oxides and sulfur dioxide. Central Power Systems include open/combined cycles and closed power systems. The combined cycle power plant concept is discussed and diagrams are included. The closed cycle gas turbine program is described as is the program on catalytic combustors. (DMC)

11559 (CONF-800334—(Vol.1), pp 375-386) **Implications of environmental compliance on DOE gasification ECT development.** Junkin, P.D.; Tipton, L.M.; Yu, W.C. (TRW Energy Systems Planning Division, McLean, VA). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

The current status and anticipated future developments of federal environmental acts and regulations affecting gasification are discussed. These include the Clean Air Act, Clean Water Act, Resource Conservation and Recovery Act, Toxic Substances Control Act, and OSHA.

11560 ESR spectra of interstitial hydrogen atoms in K_2SiF_6. Hasegawa, A.; Nishikida, K.; Williams, F. (Univ. of Tennessee, Knoxville). *Journal of Physical Chemistry, The ;* **84**: No. 26, 3630-3633(25 Dec 1980).

Well-resolved ESR spectra of hydrogen atoms trapped in K_2SiF_6 have been observed at temperatures above -60°C after the irradiation of K_2SiF_6 powder at -196°C. The spectrum recorded at -55°C showed an excellent fit to the spectrum simulated under the assumption that the hydrogen atom interacts with six nearest-neighbor fluorine nuclei in octahedral symmetry. Being associated with the cubic structure of K_2SiF_6, this fact suggests that the hydrogen atoms are in the interstitial sites in K_2SiF_6 surrounded with six nearest fluorine atoms in octahedral symmetry and eight next-nearest potassium atoms in cubic symmetry. Hydrogen atoms are also trapped in interstitial sites in $(NH_4)_2SiF_6$ as well as those in K_2SiF_6.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

REFER ALSO TO CITATION(S) 11515

5101 Basic Studies

REFER ALSO TO CITATION(S) 10168, 11659

11561 (LA—8577-PR, pp 70-86) **Environmental Science Group (LS-6).** Oct 1980.

In Biomedical and Environmental Research Program of the LASL Life Sciences and Health Divisions. Progress report, January-December 1979.

A primary focus of the Environmental Science Group activities is upon the requirements for information on the air, water, and land disturbances resulting from energy developments. Current research activities include pollutant source characterization, identification of mobile contaminants, transport of pollutants in the environment, assessment of the effects of environmental pollutants, and the identification or development of methods to control environmental contaminants. Specific research programs in support of developing energy technologies include environmental assessment of geothermal systems, impacts and stabilization of uranium mill tailings, hazards of solar heat transfer fluids, and transport of contaminants by air- and water-borne sediments. In the area of nuclear waste management, projects include assessment of low-level waste disposal sites, the attenuation of radionuclides in liquid wastes by soil, and the assessment of the environmental control technologies in the DOE nuclear waste management program.

11562 (LA—8577-PR, pp 88-109) **Health Division Organization (1979).** Oct 1980.

In Biomedical and Environmental Research Program of the LASL Life Sciences and Health Divisions. Progress report, January-December 1979.

In the first three papers of this section, interim soil limits for decontamination and decommissioning projects, information to the Eniwetak people and toxicology studies of selected materials of interest to the oil shale industry are summarized. The remainder of this section is devoted to research done at the Los Alamos National Environmental Research Park. A range of disturbed and undisturbed areas exists which affords investigations into EIK migratory patterns, fire ecology and the status of flora in the park. In addition, radionuclide tracer studies of soils and vegetation have been done. (KRM)

11563 (PNL—3618) Measuring soil water content using gypsum blocks with long leads. Sauer, R.H.; Hof, P.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1981. Contract AC06-76RLO1830. 15p. NTIS, PC A02/MF A01.

This paper describes a system for measuring soil water status quickly and accurately at several sites from a central location. The heart of the system is an instrument, developed at the Pacific Northwest Laboratory, that compensates for the capacitance in the long leads between the gypsum blocks and switching unit that connects each block to the instrument. Advantages of the system are: data collection time can be reduced by as much as 90 percent; digital display eliminates interpolation and therefore yields more accurate data; and damage to the sampling area from trampling or compaction is avoided.

11564 **Collidine sorption on a silt loam soil and a spent shale.** Routson, R.C.; Li, S.W. (Battelle Pacific Northwest Labs., Richland, WA). *Soil Science ;* **130**: No. 5, 233-237(Nov 1980).

A laboratory study was made to assess the sorption of collidine on a Ritzville silt loam soil and a retorted oil shale from the Laramie Energy Research Center. Collidine sorption was found to fit a Langmuir isotherm type sorption on both the soil and spent shale systems. In the case of the soil, two Langmuir type equations were resolved from the data, though only a single equation was resolved from the retorted shale data. Langmuir sorption capacity and bonding term parameters were determined for both systems by linear regression analysis.

11565 **Forest succession models.** Shugart, H.H. Jr.; West, D.C. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Bioscience ;* **30**: No. 5, 308-313(May 1980).

Studies in succession attempt to determine the changes in species composition and other ecosystem attributes expected to occur over periods of time. Mathematical models developed in forestry and ecology to study ecological succession are reviewed. Tree models, gap models and forest models are discussed. Model validation or testing procedures are described. Model applications can involve evaluating large-scale and long-term changes in the ambient levels of pollutants and assessing the effects of climate change on the environment. (RJC)

5102 Chemicals Monitoring And Transport

11566 **(ORNL/TM—7379) Calculation of probabilities of transfer, recurrence intervals, and positional indices for linear compartment models. Environmental Sciences Division Publication no. 1544.** Carney, J.H.; DeAngelis, D.L.; Gardner, R.H.; Mankin, J.B.; Post, W.M. (Oak Ridge National Lab., TN (USA)). Feb 1981. Contract W-7405-ENG-26. 74p. NTIS, PC A04/MF A01.

Six indices are presented for linear compartment systems that quantify the probable pathways of matter or energy transfer, the likelihood of recurrence if the model contains feedback loops, and the number of steps (transfers) through the system. General examples are used to illustrate how these indices can simplify the comparison of complex systems or organisms in unrelated systems.

11567 **(PB—80-811805) Soil erosion control. July, 1979-May, 1980 (a bibliography with abstracts). Report for Jul 79-May 80.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 116p. NTIS PC N01/MF N01.

Soil erosion sources and control methods are reviewed in these research reports. Abstracts are included of reports relative to beach and highway erosion control and forward area airfield dust control. (This updated bibliography contains 107 abstracts, 57 of which are new entries to the previous edition.)

11568 **(PB—80-811813) Soil erosion control. 1964-Jun 79 (a bibliography with abstracts). Report for 1964-Jun 79.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 295p. NTIS PC N01/MF N01.

Soil erosion and control methods are reviewed in these research reports. Abstracts are included of reports relative to beach and highway erosion control and forward area airfield dust control. (This updated bibliography contains 288 abstracts, none of which are new entries to the previous edition.)

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 11554, 11561, 11562, 11566

11569 **(PB—80-190598) Two-measurement methods for working-level determinations of radon daughters, a theoretical study. Report of investigations 1980.** Holub, R.F. (Bureau of Mines, Denver, CO (USA). Denver Research Center). 1980. 56p. (BM-RI—8422). NTIS, PC A04/MF A01.

The Bureau of Mines has evaluated four working-level radiation-measurement methods and optimized them from the inherent and statistical error standpoint. Optimization with respect to various sampling and measurement times yielded no marked improvement over the existing methods. However, when appropriate approximations are made and evaluated, these two-measurement methods can be reduced to simple formulas, eliminating a need to use nomograms. These modified methods also have improved inherent error characteristics. A new method--a combination of two existing methods--with improved inherent and statistical errors has been suggested. All the pertinent equations are given, together with the computer program, so that any two-measurement method can be readily evaluated.

11570 **(RFP—3115) Environmental Studies Group progress report for 1979.** Hunt, D.C.; Hurley, J.D. (eds.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 21 Jan 1981. Contract AC04-76DP03533. 57p. NTIS, PC A04/MF A01.

The 1979 progress report gives descriptions, results, and/or status on programs involving (1) physical transport of radionuclides in blowing dust, (2) radionuclide distributions in the sediment of area water bodies, (3) management of open space lands (including a remote sensing program) at Rocky Flats, (4) the ecology and radioecology of terrestrial open space areas in Plant site lands, (5) biological pathways for radionuclide transport, (6) evaluations of environmental monitoring data on radionuclides in air and water, (7) results of a special soil sampling program on lands adjacent to the Plant site, and (8) two special programs - one concerning evaluations of epidemiological studies of health effects purported to be related to the Plant, and a second that specifies information on accumulations of material in process building filter plenums required for evaluation of potential accidents.

11571 **(UCID—18869) Equatorial hydrology studies by satellite telemetry.** Clegg, B.; Koranda, J.; Robison, W.; Holladay, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Dec 1980. Contract W-7405-ENG-48. 22p. NTIS, PC A02/MF A01.

We are using a geostationary satellite functioning as a transponder to collect surface environmental data to describe the fate of soil-borne radionuclides. The remote, former atomic testing grounds at the Enewetak and Bikini Atolls present a difficult environment in which to collect continuous field data. Our land-based, solar-powered microprocessor and environmental data systems remotely measure net and total solar radiation, rain, humidity, temperature, and soil-water potentials. For the past year, our water-flux model predicted wet season plant-transpiration rates nearly equal to the 6- to 7-mm/d evaporation-pan rate, which decreases to 2 to 3 mm/d for the dry season. From the microclimate data we estimated a 1:3 and 1:20 ^{137}Cs dry-matter concentration ratio, which was later confirmed by radioisotopic analysis. This ratio exacerbates the dose to man from intake of food plants. Nephelometer measurements of airborne particulates presently indicate a minimum respiratory radiological dose.

11572 **(Y/DK—266) Analysis of uranium in urine by laser-induced fluorescence.** Hinton, E.R. Jr. (Oak Ridge Y-12 Plant, TN (USA)). 13 Feb 1981. Contract W-7405-ENG-26. 14p. NTIS, PC A02/MF A01.

A laser-induced fluorescence method for uranium analyses in urine has been evaluated as a possible alternative to the normal sodium fluoride-lithium fluoride flame-fusion fluorescence procedure. The effects of quenching are reduced due to the large sample dilutions that are possible with this method.

11573 **Soil chromatographic movement of technetium-99 through selected Minnesota soils.** Balogh, J.C.; Grigal, D.F. (Univ. of Minnesota, St. Paul). *Soil Science ;* **130**: No. 5, 278-282(Nov 1980).

We monitored the movement of technetium-99 through 41 samples of Minnesota soils, using soil column layer chromatography (CLC), a modification of soil thin layer chromatography. Under the aerobic conditions of soil CLC, ^{99}Tc occurs as the pertechnetate anion. Pertechnetate movement in the soils was characterized by the traditional R/sub f/ chromatographic parameter. Reduced R/

sub f/ values were statistically related to elevated levels of soil organic matter. Complexation of ^{99}Tc, related to soil organic matter, was weak. Elution patterns of ^{99}Tc in the soil CLC columns were asymmetric, with pertechnetate retardation associated with both hydrodynamic dispersion and weak retention. Pertechnetate was less mobile than was Cl^- in selected soils by soil CLC.

5105 Site Resource And Use Studies

11574 (PB—80-184500) Iowa Department of Environmental Quality, annual report 1978-1979. (Iowa Dept. of Environmental Quality, Des Moines (USA)). 1980. 35p. NTIS, PC A03/MF A01.

The 1978-1979 Annual Report discusses the Iowa Department of Environmental Quality's major activities and programs for the 1978-79 fiscal year. Along with highlighting Iowa's environmental efforts and achievements, the report also focuses on the state's environmental needs. The major areas covered in the report are: DEQ Organization, Air and Land Quality, Chemicals and Water Quality, Regional Programs, Compliance and Planning, Administrative Services and the Financial Summary.

5106 Regulations

REFER ALSO TO CITATION(S) 10284

11575 (BDX—613-2575) Spill prevention control and countermeasure plan. (Bendix Corp., Kansas City, MO (USA)). Jan 1981. Contract AC04-76DP00613. 57p. NTIS, PC A04/MF A01.

This report includes facility descriptions for both oil and hazardous chemicals storage. It gives oil spill history; regulatory guideline conformance; local emergency arrangements; evacuation procedures and the contingency plan for oil and hazardous substances. (PSB)

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 10603, 10605, 11518, 11709

11576 (PB—80-812241) Water quality modeling - hydrological and limnological systems. July, 1977-May, 1980 (a bibliography with abstracts). Report for Jul 77-May 80. Carrigan, B. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 230p. NTIS PC N01/MF N01.

The abstracts contain information on models used to describe water quality, including models of the chemical, physical, biological, and hydrological processes important to water quality. Studies are included on the modeling of eutrophication, nutrient removal, pollutant dispersion, stream flow, heat dissipation, limnological factors, aquifer water quality, and water runoff quality. (This updated bibliography contains 219 abstracts, 19 of which are new entries to the previous edition.)

11577 Shells of Physa gyrina (Gastropoda: Physidae) observed as substitute case-making material by Glossosoma intermedium (Trichoptera: Glossosomatidae). Anderson, R.V. (Western Illinois Univ., Macomb); Vinikour, W.S. *Entomological News ;* **91**: No. 3, 85-87(May 1980).

A specimen of Glossosoma intermedium (Klapalek) was collected that had incorporated snail shells into its last instar case.

11578 Fossil diatoms and scales of Chrysophyceae in the recent history of Hall Lake, Washington. Munch, C.S. (Hood Coll., Frederick, MD). **10**: 61-66(1980).

Scales of several members of the Chrysophyceae (family Synuraceae) were examined from a core of the recent sediments of Hall Lake, Washington, in conjunction with a study of fossil diatoms. Both types of microfossils revealed communities changing with the historical development of the lake. Increases in planktonic diatoms and in two species of Mallomomonas occurred about the time of European settlement. Several acidophilous species among the Chrysophyta disappeared with the establishment of a sawmill and meromictic conditions in the lake. When extensive road construction around the lake ended the period of meromixis, the ratio of Synuraceae, in general, to diatoms, declined. Besides the change in ratio of Synuraceae to diatoms there was a change in the composition of the community of Synuraceae at that time. Species of Synura that had been rare before became the most abundant, and Mallomonas became relatively rare. Throughout the recent history of the lake the dominant Synuraceae seemed to respond more strongly to disturbance around the lake than the most abundant diatoms; thus, scales of Mallomonas, Synura, and other Synuraceae are valuable microfossils for paleolimnological studies.

11579 Effects of dilution on the benthos of an alkaline lake. Wiederholm, T. (Dept. of Entomology, Uppsala, Sweden). *Hydrobiologia ;* **68**: No. 3, 199-207(1980).

Lake Lenore is a highly productive alkaline lake in the Lower Grand Coulee, Central Washington. Leakage of freshwater from nearby irrigation projects decreased the lake salinity from about 17 to 1.5 g/l during 1950-1975. The initial bottom fauna with mass occurrence of single halobiontic chironomid species was supplanted by more diverse communities at all depths. The species richness increased by 2-8 times. The greatest addition of new species was found in the salinity range of 2-3 g/l. Concurrent increases in abundance and biomass suggest that the carrying capacity of the lake at higher salinities was not fully utilized by the benthos. A comparison with other eutrophic saline lakes indicates that benthic species composition and quantity is correlated with total salinity and ion composition.

11580 Glochidiosis of salmonid fishes. IV. Humoral and tissue responses of coho and chinook salmon to experimental infection with Margaritefera Margaritifera (L.) (Pelecypoda: Margaritanidae). Meyers, T.R.; Millemann, R.E.; Fustish, C.A. Contract W-7405-ENG-26. *Journal of Parasitology, The ;* **66**: No. 2, 274-281(1980).

Coho salmon (Oncorhynchus kisutch) are more resistant than chinook salmon (O. tshawytscha) to experimental infection with the glochidia of the freshwater mussel Margaritifera margaritifera. Histological sections of gills from coho salmon 16 hr postinfection (p.i.) showed that parasite encystment either did not occur or had progressed incompletely, which accounted for the loss of many glochidia from the gills. The remaining encysted glochidia were sloughed within 2 days (p.i.) by a well-developed hyperplasia. On chinook salmon, the parasites developed normally with no sloughing or hyperplasia. Analysis of blood samples taken from coho salmon at intervals during the infection showed significant increases in hematocrit, hemoglobin, the mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and leukocyte numbers when compared with control fish. In infected chinook salmon only the hematocrit, erythrocyte numbers, and MCV increased while the MCHC decreased. Total plasma protein increased in coho salmon but decreased in chinook salmon during infection. Glochidial antibodies were demonstrated in the blood plasma of coho and chinook salmon 8 to 12 wk p.i. Fewer glochidia attached to the excised gills of coho salmon than to the gills of chinook salmon. Also, the in vitro survival time of parasites in mucus and plasma from coho salmon was less than in the same chinook salmon fluids.

11581 Relationship between egg size and naupliar size in the calanoid copepod Diaptomus clavipes Schacht. Cooney, J.D.; Gehrs, C.W. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Limnology and Oceanography ;* **25**: No. 3, 549-552(1980).

A direct positive relationship was demonstrated between egg size and naupliar size in the calanoid copepod Diaptomus clavipes Schacht. Number of eggs per clutch and total clutch volume were inversely associated with measures of egg and naupliar size (egg volume, maximum egg length, naupliar volume, and maximum naupliar length). Thus, small clutches with large eggs give rise to large nauplii.

5202 Chemicals Monitoring And Transport

11582 (PB—80-182728) Laboratory procedures: analysis of sodium-based dual-alkali process streams. Report for Jul 78-Jan 80. Donnelly, J.R.; Shepley, D.C.; Martin, T.M.; Abdulsattar, A.H. (Bechtel National, Inc., San Francisco, CA (USA)). Mar 1980. 162p. NTIS, PC A08/MF A01.

The report gives procedures for chemical analysis of process streams of a flue gas desulfurization (FGD) system (utilizing the Combustion Equipment Associates/Arthur D. Little sodium-based dual-alkali process) at Louisville Gas and Electric's Cane Run Unit 6. The U. S. EPA has contracted with Bechtel to develop and implement a test program to characterize this FGD process. As part of this effort, Bechtel has established a laboratory at the site for routine chemical analyses of the process streams. The methods used for these chemical analyses comprise this laboratory procedures manual. The procedures were extracted from three principal sources: 'Chemical Analysis Procedures for Dual Alkali Process Stream Samples,' A. D. Little report No. 75833, 4/22/76; 'Laboratory Procedures Manual,' Shawnee Test Facility, Paducah, KY, prepared by Bechtel, 3/76; and 'Standard Methods for the Examination of Water and Wastewater,' 14th edition, 1975. Procedures were verified by on-site analyses in accordance with the quality assurance section of this report. In some cases, modifications adapted the standard procedures to the specific process conditions and to best utilize available resources.

11583 (PB—80-185572) Waste and water management for conventional coal combustion: assessment report - 1979. Volume V. Disposal of FGC (flue gas cleaning) wastes. Final report Sep 77-Aug 79. Santhanam, C.J.; Lunt, R.R.; Cooper, C.B.; Klimschmidt, D.E.; Bodek, I. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Mar 1980. 333p. NTIS, PC A15/MF A01.

The report, the fifth of five volumes, focuses on disposal of coal ash and FGD wastes which (together) comprise FGC wastes. The report assesses the various options for the disposal of FGC wastes with emphasis on disposal on land. A number of technical, economic, and regulatory factors appear to encourage increasing use of dry disposal methods. Regulatory considerations impacting FGC waste disposal are assessed. An assessment of the monitoring requirements from the viewpoints of regulation and environmental control is reported. Ongoing studies on the economics of FGC waste disposal are reported and assessed. Environmental impact issues concerning disposal options include physical stability, public policy and land use, and leachate mobility.

11584 (DOE/ET/11351—3) Adsorption of organic acids from dilute aqueous solution onto activated carbon. Wang, S.W. (Colorado School of Mines, Golden (USA)). [nd]. Contract AS04-76ET11351. 141p. NTIS, PC A07/MF A01.

The radioisotope technique was used to study the removal of organic acid contaminants from dilute aqueous solutions onto activated carbon. Five single-solute systems (acetic acid, propionic acid, n-butyric acid, n-hexanoic acid, and n-heptanoic acid) were studied at three different temperatures, 278, 298, and 313°K. Three bi-solute acid mixtures (A. acetic and propionic acids, B. acetic and butanoic acids, and C. propionic and butanoic acids) were studied at two different temperature 278 and 298°K. The purposes of this study are two-fold. First, experimental isotherms of single-solute systems were obtained at three different temperatures in the very dilute concentration region (less than 1% by weight). These data are very important in the prediction of bi-solute equilibrium data. Secondly, a Polanyi-based competitive adsorption potential theory was developed in this study and used to predict the bi-solute equilibrium uptakes. The calculated values were compared with both experimental data and equilibrium uptakes as predicted by ideal adsorbed solution theory. The average errors between the values calculated by the competitive adsorption potential theory and experimental data ranges from 4% to 14%. It was found in this study that the competitive adsorption potential theory gives slightly better results than those calculated by ideal adsorbed solution theory.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 11566

11585 (IS—4743) Multilaboratory analytical quality control for the hydrogeochemical and stream sediment reconnaissance. Quality control report for April 1980. D'Silva, A.P.; Grabau, F.; Haas, W.J. Jr. (Ames Lab., IA (USA)). Jun 1980. Contract W-7405-EN-82. 52p. NTIS, PC A04/MF A01.

For the month of April 1980 the results of uranium determinations in water and sediment samples from Los Alamos Scientific Laboratory and Oak Ridge Gaseous Diffusion Plant are presented. (ACR)

5204 Thermal Effluents Monitoring And Transport

11586 (PB—80-184062) High frequency temperature fluctuations in a power-plant thermal plume. Technical report. Green, T.; Roffler, S. (Wisconsin Univ., Madison (USA). Water Resources Center). 1980. 69p. NTIS, PC A04/MF A01.

High-frequency temperature variations were measured at seven depths, from the water surface to three meters, at a point 130 meters from the cooling-water outfall of a power plant on Lake Michigan. The data are analyzed using spectra, correlation functions, and probability distributions. The sharp thermal fronts observed in the data are related to the surface thermal fronts seen using airborne infrared scanning, and to laboratory studies of instabilities in mixing layers between uniformly flowing and quiescent fluids.

11587 (PB—80-188691) Phosphorus dynamics in a North Carolina Piedmont reservoir. Kuenzler, E.J.; Greer, L.E. (North Carolina Water Resources Research Inst., Raleigh (USA)). Jan 1980. 68p. NTIS, PC A04/MF A01.

University Lake, a water-supply impoundment in the Piedmont Province of North Carolina, was sampled twice monthly for ten months to determine the patterns of phosphate uptake at different depths throughout the year. The lake is oxygenated at all depths in winter but beginning in March, thermal stratification prevents oxygen transport to the hypolimnion.

11588 (PB—80-192313) Evaluation of the effects of the thermal discharge on the submerged aquatic vegetation and associated fauna in the vicinity of the C.P. Crane Generating Station. Final report Jun-Sep 79. Nichols, B.L.; Anderson, R.; Banta, W.; Forman, E.J.; Boutwell, S.H. (Science Applications, Inc., McLean, VA (USA)). 1 Feb 1980. 216p. NTIS, PC A10/MF A01.

The study was designed to: Characterize the submerged and rooted aquatic vegetation in Seneca Creek, Saltpeter Creek, Dundee Creek and portions of the lower Gunpowder River (Chesapeake Bay, Maryland). Determine whether the C.P. Crane Generation Station affects the species composition, producitivity, and growth of the submerged and rooted aquatic vegetation in the vicinity of the plant. Determine whether the fauna species associated with the submerged aquatic vegetation are affected by the heated effluent.

5205 Site Resource And Use Studies

11589 (DOE/EV/10180—1) Water-related planning and design at energy firms. Abbey, D.; Lucero, F. (Los Alamos Scientific Lab., NM (USA)). Nov 1980. Contract AC04-80EV10180. 45p. NTIS, PC A03/MF A01.

Water related planning and design at energy firms are examined. By identifying production alternatives and specifying the cost of these alternatives under a variety of conditions, one gains insight into the future pattern of water use in the energy industry and the response of industry to water-related regulation. In Part II, the three principal decisions of industry that affect water allocation are reviewed: where to build plants, where to get water, and how much water to use. The cost of water use alternatives is reviewed.

Part III presents empirical data to substantiate the inferences derived from engineering/economic analysis. The source of water, type of cooling system, and pattern of discharge for electric plants constructed during the 1970s or projected to come on line in this decade are reported. In the 1970s in the US, there was a trend away from once-through cooling toward use of evaporative cooling. Freshwater, as a source of supply, and discharge of effluent were standard practice. In the 1980s, almost all new capacity in the states and basins surveyed will use evaporative cooling. It is pointed out that a thorough understanding of industrial water use economics and water markets is a precursor to successful regulation.

11590 **(PB—80-184104) A summary and analysis of environmental information on the Continental Shelf and Blake Plateau from Cape Hatteras to Cape Canaveral (1977). Volume I, Book 2. Chapters VIII thru XIII. Final report.** (Center for Natural Areas, South Gardiner, ME (USA)). Aug 1979. 637p. NTIS, PC A99/MF A01.

A 12-month study by the Center for Natural Areas was conducted to collect and analyze published, unpublished, and raw data as well as ongoing research programs from 1974 to present, relative to the marine environment of the outer continental shelf and the Blake Plateau from Cape Hatteras, North Carolina to Cape Canaveral, Florida. The report is to be used to assess adequacy of the regional data base, and may be used in the design of environmental studies that the Bureau of Land Management will direct in an attempt to assess and predict the possible effects of oil and gas development on the marine life and environment.

11591 **(PB—80-184112) Summary and analysis of environmental information on the Continental Shelf and Blake Plateau from Cape Hatteras to Cape Canaveral (1977). Volume 1, Book 3. Chapters XIV thru XVII. Final Report.** (Center for Natural Areas, South Gardiner, ME (USA)). Aug 1979. 623p. NTIS, PC A99/MF A01.

A 12-month study by the Center for Natural Areas was conducted to collect and analyze published, unpublished, and raw data as well as ongoing research programs from 1974 to present, relative to the marine environment of the outer continental shelf and the Blake Plateau from Cape Hatteras, North Carolina to Cape Canaveral, Florida. The report is to be used to assess adequacy of the regional data base.

11592 **(PB—80-184120) Summary and analysis of environmental information on the Continental Shelf and Blake Plateau from Cape Hatteras to Cape Canaveral (1977). Volume 1, Book 4. Chapters XVII thru XX. Final report.** (Center for Natural Areas, South Gardiner, ME (USA)). Aug 1979. 662p. NTIS, PC A99/MF A01.

A 12-month study by the Center for Natural Areas was conducted to collect and analyze published, unpublished, and raw data as well as ongoing research programs from 1974 to present, relative to the marine environment of the outer continental shelf and the Blake Plateau from Cape Hatteras, North Carolina to Cape Canaveral, Florida. The report is to be used to assess adequacy of the regional data base, and may be used in the design of environmental studies that the Bureau of Land Management will direct in an attempt to assess and predict the possible effects of oil and gas development on the marine life and environment.

11593 **(PB—80-186521) Environmental effects of western coal surface mining. Part V: Age and growth of walleyes and saugers in the Tongue River Reservoir, Montana, 1975-77. Final report.** Riggs, V.L.; Gregory, R.W. (Montana Cooperative Fishery Research Unit, Bozeman (USA)). Mar 1980. 56p. NTIS, PC A04/MF A01.

A study was conducted between 1975-1977 on the populations of walleye (Stizostedion vitreum) and sauger (Stizostedion canadense) in the Tongue River Reservoir, in southeastern Montana. The Tongue River Reservoir is the recipient of mine water effluents from the Decker Mine, the largest surface coal mine in the western United States. The objective of the study was to determine possible impacts of the mine on the walleye and sauger populations in the reservoir, and to provide data against which future comparisons can be made. These species were chosen because they are two of the most important game fishes in the reservoir. The age and growth of 640 walleyes and 546 saugers were determined from collections made in gill nets, trap nets, and by electrofishing.

5206 Regulations

REFER ALSO TO CITATION(S) 10284, 11016, 11559

11594 **(PB—80-186455) Iowa statewide water quality management plan, 1979.** (Iowa Dept. of Environmental Quality, Des Moines (USA)). Sep 1979. 221p. NTIS, PC A10/MF A01.

In accordance with the requirements of Section 208 of the Federal Water Pollution Control Act of 1972, Iowa has completed a Statewide Water Quality Management Plan. The plan assesses the current surface water quality in Iowa in terms of point and nonpoint source pollution, identifies existing Iowa Department of Environmental Quality and Iowa Department of Soil Conservation programs dealing with these pollution sources, discusses federal, state, county and local management agencies involved in some way with water quality activities, and identifies the planning activities and public participation involved in developing the final plan. The plan includes a five-year strategy, which will be used for implementing statewide water pollution control program activities.

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

11595 (CONF-800334—(Vol.2), pp 405-416) **Socioeconomic and institutional considerations for waste management.** Finley, J.R. (Battelle Memorial Institute, Columbus, OH). Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

Principal activities of the socio-economic program at the Office of Nuclear Waste Isolation are discussed. The social and economic impacts of repository development are classified as standard (those which would be associated with any large mining project) and special (those which are unique to the construction and operation of a nuclear waste facility). These are discussed. Research is being conducted to identify possible impact mitigation strategies. (DMC)

11596 (CONF-8004110—, pp 217-223) **CO_2: attitudes and implications.** Weinberg, A.M. (Oak Ridge Associated Universities, TN). Dec 1980.

From DOE research conference on CO/sub 2/; Washington, DC, USA (24 Apr 1980).

The CO_2 question is now a dismayingly large political issue. The attitudes of scientists and politicians toward this issue range all the way from the position that there is no problem to the view that CO_2 is a big deal. A few illustrations of how widely these attitudes vary are presented.

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 10318, 10489, 10773, 11014

11597 **(LA—8656-MS) Uranium mining and milling work force characteristics in the western US.** Rapp, D.A. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 44p. NTIS, PC A03/MF A01.

This report presents the results of a survey of the socioeconomic characteristics associated with 11 uranium mine and mill operations in 5 Western States. Comparisons are made with the socioeconomic characteristics of construction and operating crews for coal mines and utility plants in eight Western States. Worker productivity also is compared with that in similar types of coal and uranium mining operations. We found that there existed no significant differences between the socioeconomic characteristics of construction and operating crews and the secondary employment impacts associated with uranium mines and mills when compared with

those associated with coal mines and utility plants requiring similar skills at comparable locations. In addition, our survey includes a comparison of several characteristics associated with the households of basic and nonbasic work forces and concludes that significant changes have occurred in the last 5 yr. Accordingly, we recommend additional monitoring and updating of data used in several economic forecasting models to avoid unwarranted delays in achieving national energy goals.

5303 Environmental Impact Statements

11598 (P—700-80-005) Final environmental impact report for the California Energy Commission Solar Program and Wind Program. (California Energy Commission, Sacramento (USA)). May 1980. 195p. California Energy Commission, Sacramento, CA.

Includes addendum.

This Final Environmental Impact Report analyzes the California Energy Commission's Solar Program and Wind Program. The Solar Program is not expected to have any significant environmental effects. The assembly of solar systems will require the manufacture of certain component materials such as steel, aluminum, glass, copper, fiberglass insulation and polyurethane insulation. With the exception of copper and aluminum, all the materials can be manufactured in California. The air quality impacts associated with the production of these materials are insignificant and, in most cases, are more than offset by reduced emissions from decreased electrical generation and natural gas consumption. There are no expected water quality impacts associated with the production of the materials. The Solar Program will also have socioeconomic effects. The purchase price of some new housing will increase as a result of installing solar systems. The Solar Program will have a positive effect on employment, increasing the number of jobs available in both the manufacturing and installation of solar systems. The Wind Program has a near-term goal of 500 megawatts of wind generated electricity on line in California by 1985. Potential sites for wind development from a wind resource standpoint, occur in the desert and mountains where strong, persistent winds occur. The siting of a specified number of wind turbines may pose potential environmental impacts, but these effects are mitigable. The most substantial concern is the need for scattered wind turbines over a given area. Construction impacts from turbine pad leveling, access roads and transmission corridors could be considerable. Conflicts with existing and future land use may also occur. Operational effects include minor changes in microclimate, bird collisions with the turbine blades, noise, increased off-road vehicle use, aesthetics and radio and television wave interference.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5502 Biochemistry

11599 (COO—2570-8) Investigation of the triplet state of chlorophylls. Progress report, May 1, 1980-Aprii 30, 1981. Clarke, R.H. (Boston Univ., MA (USA). Dept. of Chemistry). 22 Dec 1980. Contract AS02-76ER02570. 13p. NTIS, PC A02/MF A01.

The triplet state of chlorophyll has been utilized as a nondestructive probe into the structural and dynamical nature of the photosynthetic apparatus. During the past year, using zero-field triplet state optically detected magnetic resonance spectroscopy, chlorophyll aggregates were examined in both their natural environment in vivo and in model complexes in vitro. Research efforts have focused on subchloroplast particles extracted from green plants, on chlorophyll monolayers, and on isolated chlorophyll molecules bound to both simple ligands and to complete proteins. The overall aim of the research program is to detail the physical features and interactions of the photosynthetic pigment systems through examination of structural subunits of the photosynthetic apparatus and model systems which represent them.

11600 Glyceraldehyde-3-phosphate dehydrogenase-catalyzed chain oxidation of reduced nicotinamide adenine dinucleotide by perhydroxyl radicals. Chan, P.C. *Journal of Biological Chemistry, The ;* **255**: No. 3, 874-876(10 Feb 1980).

The chain oxidation of glyceraldehyde-3-phosphate dehydrogenase NADH by perhydroxyl radicals and propagated by molecular oxygen was studied by the xanthine-xanthine oxidase system, ^{60}Co γ-ray, and pulse radiolysis. The chain length, amount of NADH oxidized per HO_2 generated, increases with increasing acidity of the medium and reaches a value of 73 at pH 5.0. The rate constant for the oxidation of the glyceraldehyde-3-phosphate dehydrogenase NADH complex by HO_2 was estimated to be 2×10^7 $m^{-1}s^{-1}$ at ambient temperatures (23-24°C). Rate studies as a function of pH indicate that O_2^- is unreactive toward the glyceraldehyde-3-phosphate dehydrogenase NADH complex. Other dehydrogenases (malate dehydrogenase, glutamate dehydrogenase, and isocitric dehydrogenase) studied showed no catalytic activity in the oxidation of NADH by HO_2/O_2^-.

11601 Liquid-chromatographic separation and on-line bioluminescence detection of creatine kinase isoenzymes. Bostick, W.D.; Denton, M.S.; Dinsmore, S.R. (Oak Ridge National Lab., TN). *Clinical Chemistry ;* **26**: No. 6, 712-717(1980).

Isoenzymes of creatine kinase were separated by anion-exchange chromatography, with use of an elution gradient containing lithium acetate (0.1 to 0.6 mol/L). A stream splitter was used to divert a 5% side stream of column effluent, which was subsequently mixed with the reagents necessary for bioluminescence assay of the separated isoenzymes. The use of the stream splitter greatly decreased the rate of consumption of reagent and, when combined with a peristaltic pumping system, permitted independent control of the side-stream flow rate. Thus both the residence interval in a delay coil in which the ATP reaction product is formed and the bioluminescence emission was monitored in a flow-through fluorometer without use of an external light source or filters. Separation and detection of the isoenzymes of creatine kinase were rapid, sensitive, and highly selective. The incremental decrease of bioluminescence response owing to inhibition by the ions in the eluent was less than 31% across the entire gradient.

11602 Dependence of mononucleosome deoxyribonucleic acid conformation on the deoxyribonucleic acid length and H1/H5 content. Circular dichroism and thermal denaturation studies. Cowman, M.K.; Fasman, G.D. *Biochemistry ;* **19**: 532-541(1980).

Four mononucleosome preparations were isolated from micrococcal nuclease digests of chicken erythrocyte nuclei which differed in average deoxyribonucleic acid (DNA) length and in H1 and H5 content. The circular dichroism properties of the unperturbed mononucleosome preparations and the corresponding H1- and H5-depleted species demonstrate that the nucleoprotein spectra above 250 nm are all altered relative to protein-free DNA by the addition of a single negative band at 275 nm, similar to the band observed for psi-DNA. The quantitative analysis of the psi type band intensity for any of the higher molecular weight unperturbed samples relative to core particle mononucleosomes yielded a constant number of DNA base pairs (~ 140) contributing to this new band. Upon removal of H1 and H5 from the mononucleosome preparations which have sufficiently long linker DNA, the psi-type band intensity indicates an ~ 30 base pair reduction in the number of core DNA base pairs contributing to the altered circular dichroism properties. The psi-type band is proposed to be due to the compact DNA tertiary structure. This interpretation implies that ~ 30 base pairs of core DNA are removed from the unique core tertiary structure when the linker DNA is not bound by H1 or H5. The circular dichroism analysis correlates well with the thermal denaturation properties of mononucleosomes. Removal of H1 and H5 causes an overall reduction in the thermal stability of both core and linker DNA. Some core DNA is lost from the highest temperature melting bands when histone-free DNA is present. These results indicate two regions of different conformational and thermodynamic stability in core DNA. The length of attached linker DNA and its histone content influence the two regions of the core to differing extents.

11603 Comparisn of DNA renewal in germ-free and conventional mice using [^{125}I]iododeoxyuridine and [^{3}H]thymidine. Webb, P. (Univ. of Notre Dame, IN); Chanana, A.D.; Cronkite, E.P.; Laissue, J.A.; Joel, D.D. *Cell and Tissue Kinetics ;* **13**: 227-237(1980).

Germ-free (GF) and conventional (CV) C3H mice received a single injection of 1 μCi [^{3}H]thymidine and 3 μCi [^{125}I]iododeoxyuridine to provide simultaneous labeling of DNA with the two precursors. Thymus, spleen, mesenteric lymph nodes, bone marrow (femora), small intestine, colon and skin were examined for total organ activity and rate of DNA renewal 1 to 8 days after injection. Precursor incorporation, assayed on day 1, was lower in the thymus, mesenteric lymph nodes and femora (and, to a lesser extent, in the spleen and colon) of GF mice as compared to CV animals. The opposite was observed in the small intestine and skin, i.e., total organ activity was higher in GF animals. Differences in precursor incorporation were partly due to differences in organ weights between the two groups of mice. In comparison to CV animals, DNA renewal rates were diminished in the mesenteric lymph nodes, bone marrow, colon (following a 3-day plateau) and spleen of GF mice. Little, if any, difference was observed between the two groups with respect to the rate of DNA turnover in the thymus and skin. Radioactivity of the small intestine remained constant for 2 days. Thereafter intestinal activity in GF mice declined at an initial slow rate between days 2 and 5 followed by a rapid decrease between days 5 and 8. In CV mice the first phase of activity loss was short with the rapid decline in intestinal activity beginning on day 3. From the slopes of the regression lines the percentage thymidine reutilization was estimated. Reutilization varied from 0 to 63% in the various organs examined, with the greatest difference between GF and CV mice occurring in the mesenteric lymph nodes.

11604 DNA synthesis in a sub-nuclear preparation isolated from Physarum polycephalum. Brewer, E.N.; Busacca, P.A. (Case Western Reserve Univ., Cleveland, OH). *Biochemical and Biophysical Research Communications ;* **91**: No. 4, 1352-1357(28 Dec 1979).

A sub-nuclear preparation capable of substantial levels of DNA synthesis in vitro has been obtained from isolated S-phase nuclei of Physarum polycephalum. Nuclei were disrupted by gentle resuspension in a dextran-free medium followed by immediate action of dextran to stabilize the liberated replication complex. Synthesis continues for at least 120 min, and appears to occur by a semi-discontinuous mechanism. Little DNA synthesis occurs in preparations obtained from G_2-phase nuclei.

11605 β and γ cytoplasmic actins are differentially thermostabilized by MgADP; γ actin binds MgADP more strongly. Anderson, N.L. (Argonne National Lab., IL). *Biochemical and Biophysical Research Communications ;* **89**: No. 2, 486-490(27 Jul 1979).

Using the technique of thermal denaturation in a temperature gradient followed by two-dimensional gel electrophoresis of the fractions, the thermostabilities of the cytoplasmic actins have been investigated. Addition of 5 mM MgADP (but not NADH or $CaCl_2$) to stripped, radiolabeled leukocyte lysate thermostabilizes the actins by about 16°C relative to stripped lysate alone, producing a slightly stronger stabilization in γ actin. This result will allow preparative fractionation of β and γ actins and additional biochemical characterization of their differences.

11606 Evidence of increased amplification of ribosomal RNA genes in germinated conidial cells of Neurospora crassa. Mukhopadhyay, D.K.; Dutta, S.K. (Howard Univ., Washington, DC). *Indian Journal of Experimental Biology ;* **17**: No. 6, 620-621(Jun 1979).

Two hundred fifty to 300 amplified ribosomal RNA genes have been found to exist in germinated conidia, the early developmental cells fo N. crassa. DNA sequences that code for ribosomal RNA in mycelial cells, fully developed cells, are known to be amplified 100 times. These results suggest significantly increased rRNA gene activity during onset of cellular differentiation.

11607 Isolation of a stimulatory factor for nuclear DNA replication. Brewer, E.N. (Case Western Reserve Univ., Cleveland, OH). *Biochimica et Biophysica Acta ;* **564**: 154-161(1979).

Aqueous extracts of isolated nuclei and intact plasmodia of Physarum contain a heat-stable stimulator of nuclear DNA replication. The stimulatory factor is present throughout the mitotic cycle, and its activity is unaffected by prior exposure of plasmodia to cycloheximide. The stimulatory substance has been partially purified by heat treatment, precipitation with ethanol, chromatography on DEAE cellulose, and gel filtration. The purified material contains both carbohydrate and protein, and exhibits a molecular weight of about 30,000. The active substance increases the rate and overall extent of DNA replication in S-phase nuclei, but does not trigger the initiation of DNA synthesis in nuclei isolated from G_2-phase plasmodia. The stimulatory material contains little or no deoxyribonuclease or DNA polymerase activity, and it does not affect DNA polymerase activity assayed using a purified DNA template.

5503 Cytology

11608 (LA—8577-PR, pp 21-34) Biophysics Group (LS-2). Oct 1980.

In Biomedical and Environmental Research Program of the LASL Life Sciences and Health Divisions. Progress report, January-December 1979.

The activities reported here deal with the development of physical techniques for quantitative cell biology. Increased emphasis has been placed on developing an in-depth understanding of the nature of the measurement process in flow cytometry. In this respect, further investigations have been accomplished into the influence of the geometry in the flow light scattering measurements. Several configurations have been considered to check compatibility of measurement results with instrument design. The influence of the fluorochrome distribution within the cell and its effect on rise time and pulse duration has also been examined. Work also continues with the fluorescent lifetime studies. The goal of this activity is to develop a technique to permit fluorochromes within cells to be used as probes for molecular structure. We have also begun an investigation into the uniqueness of the several morphological features of cells that can be detected with slit scan flow techniques. The point of this systems analysis approach is to determine the limitations of present approaches with a handle to development of higher resolution techniques, were required.

11609 Variations in sample preparation that affect contrast enhancement by lead aspartate. Yoshiyama, J.M.; Goff, D.; Walton, J. (Lawrence Livermore Lab., CA). Contract W-7405-ENG-48. pp 654-655 of 38th annual proceedings of Electron Microscopy Society of America, San Francisco, CA. Bailey, G.W. (ed.). Ithaca, NY; Electron Microscopy Society of America (1980).

The present study was undertaken to determine how differences in sample protocol affect lead aspartate contrast enhancement, making a strict effort to obtain comparable samples. Lead aspartate staining failure occurs when lead ions are removed from the staining solution. Unlike most other lead solutions used in histochemistry, lead aspartate stain should never require filtration before use. If lead salts precipitate from the solution during storage, preparation, or use (as from inadequate washing after fixation), contrast enhancement may not occur.

5504 Genetics

REFER ALSO TO CITATION(S) 11630

11610 (DOE/ER/10581—T1) Differential gene expression in C4 plants. Progress report, February 1, 1980-January 31, 1981. Cashmore, A.R.; Chua, N.H. (Rockefeller Univ., New York (USA)). Nov 1980. Contract AC02-80ER10581. 7p. NTIS, PC A02/MF A01.

The differential expression of nuclear genes encoding the small subunit of ribulose-1,5-bisphosphate (RuP_2) carboxylase is being studied. In C4 plants this polypeptide is found in chloroplasts from bundle sheath cells but it is not present in chloroplasts from

mesophyll cells. We have shown that the absence of the small subunit from corn mesophyll chloroplasts is not due to a defect in uptake and processing. We conclude this as isolated mesophyll chloroplasts are competent in the uptake and processing of the precursor for the small subunit of barley RuP_2 carboxylase. Using recombinant DNA procedures we have cloned DNA sequences which are complementary to the messenger RNA encoding the small subunit of RuP_2 carboxylase. This cloned DNA has been used in molecular hybridization studies to examine the nature of the nuclear DNA encoding the small subunit. Digestion of corn DNA with the restriction enzymes FcoRI and BamHI yields multiple DNA sequences which are complementary to the cloned DNA. Studies are in progress to determine whether the nature of these nucleas DNA sequences differ in isolated mesophyll and bundle sheath cells. Studies of this nature will allow us to determine whether differential expression of the gene for the small subunit of RuP_2 carboxylase is determined at the DNA sequence level.

11611 **(DOE/EV/06024—1) Nonrandom mutagenesis. Progress report, March 1, 1981-February 28, 1982.** Goldsby, R.A. (Maryland Univ., College Park (USA)). 1981. Contract AS05-78EV06024. 18p. NTIS, PC A02/MF A01.

The ultimate goal is the development of tools, approaches and systems which will increase our ability to detect and control mutagenesis. We have continued to develop hybrid cell lines suited to the investigation of the expression and mutagenesis of human cell surface markers. The development and characterization of the monoclonal antibody probes to identify and characterize variation in selected human cell surface antigens has continued. Human X mouse T lymphoma hybrids have proven valuable in obtaining clonal populations expressing cell surface determinants characteristic of particular differentiated cell types. We have constructed a set of human lymphocyte X mouse T lymphoma hybrids which have proven useful for the mapping of cell surface determinants to particular chromosomes.

11612 (LA—8577-PR, pp 35-49) **Genetics Group (LS-3).** Oct 1980.

In Biomedical and Environmental Research Program of the LASL Life Sciences and Health Divisions. Progress report, January-December 1979.

Gene expression may be affected by energy-related pollutants in two fundamentally different ways. First, the pollutants may damage the DNA. The consequences of functional genetic damage include the production of mutations and, presumably, cancer. Such studies on DNA damage and related studies on the nature and role of cellular promutagen-activation and recovery or repair systems constitute the Mutagenesis Program. Secondly, pollutants may induce gene expression. That is, they may initiate specific transcriptional or translational events. These genetic and epigenetic pollutant effects prove powerful tools for studying the mechanisms involved in induction of specific gene expression.

11613 **14q+ chromosome in pre-B-ALL.** Kaneko, Y. (Univ. of Chicago, IL); Rowley, J.D.; Check, I.; Variakojis, D.; Moohr, J.W. Contract EY-76-C-02-0069. *Blood ;* **56**: No. 5, 782-785(Nov 1980).

A child who had acute lymphoblastic leukemia (ALL) associated with an 8;14 chromosome translocation and with a pre-B phenotype is described. The leukemic cells were determined to be pre-B-cells on the basis of intracytoplasmic μ-chain immunoglobulin (cIgM+) and the common-ALL antigen, lack of receptors for sheep erythrocytes, and lack of surface immunoglobulin. Thus far, no karyotypes have been reported for patients with pre-B-ALL. The present case indicates that a 14q+ chromosome may provide a proliferative advantage not only to cells with a B-cell phenotype, but also to pre-B cells. The short survival of our patient also suggests that the 14q+ abnormality and the pre-B phenotype may signal a poor prognosis.

11614 **Do homologous chromosomes differ. A preliminary investigation based on DNA measurements.** Moore, D.H. II; Carrano, A.V.; Mayall, B.H. (Univ. of California, Livermore). *Cytogenetics and Cell Genetics ;* **23**: 108-116(1979).

This paper is concerned with the problem of deciding whether measurements from homologous chromosomes differ. First, a general mathematical model is proposed for studying the distribution of chromosome measurements. Next, log-likihood ratios are used to test for correlation between homolog pairs and for differences between homolog means and variances. The tests are applied to measurements on 1946 pairs of chromosomes from 10 normal individuals. Test results are interpreted taking into account the large number (2025 total tests) required by the study. Our results demonstrate that, at the current level of resolution, most homologs do not show differences in DNA content. However, there is some evidence that several homolog pairs differ by small amounts of DNA (less than 0.2% of the autosomal genome). Power studies indicate that sample sizes of 20 to 30 measurements are required to detect differences of this size.

5505 Metabolism

11615 **Proteins iodinated by the chloramine-T method appear to be degraded at an abnormally rapid rate after endocytosis.** Opresko, L. (Univ. of Tennessee, Oak Ridge); Wiley, H.S.; Wallace, R.A. *Proceedings of the National Academy of Sciences of the United States of America ;* **77**: No. 3, 1556-1560(Mar 1980).

Proteins labeled with either ^3H by reductive methylation or ^{125}I by the chloramine-T method were incubated with Xenopus laevis oocytes; the incorporation and acid precipitability of the proteins were then studied. The uptake rates of both specifically incorporated (vitellogenin) and nonspecifically incorporated proteins (bovine serum albumin and X. laevis serum proteins lacking albumins) were not influenced by the method of labeling. However, ^{125}I-labeled proteins were apparently degraded at rates far exceeding their ^3H-labeled counterparts, based on the generation of acid-soluble radioactivity. Apparent degradation rates observed for endocytotically incorporated proteins may vary depending on the method used to label the protein and caution should be exercised when interpreting results obtained with labeled, particularly chloramine-T labeled, proteins.

5506 Medicine

REFER ALSO TO CITATION(S) 11645, 11652, 11808

11616 **(FDA—79-8033) Bureau of Radiological Health publications index.** (Department of Health, Education, and Welfare, Rockville, MD (USA)). Aug 1979. 200p. GPO.

The Key Word in Context (KWIC) index to the publications of the Bureau of Radiological Health was prepared to aid in the retrieval and identification of publications originated or authored by Bureau staff or published by the Bureau. These publications include journal articles, government publications and technical reports, selected staff papers, and Bureau news releases issued by HEW. For convenience, the document is divided into four sections, KWIC Index, Author Index, Bibliography Index, and BRH Publications Subject Index.

11617 **Specific absorbed fractions for photon sources uniformly distributed in the heart chambers and heart wall of a heterogeneous phantom.** Coffey, J.L. (Oak Ridge Associated Universities, TN); Cristy, M.; Warner, G.G. *Journal of Nuclear Medicine ;* **22**: No. 1, 65-71(Jan 1981).

From 28. annual meeting of Society of Nuclear Medicine; Las Vegas, NV, USA (16 Jun 1981).

As part of the responsibilities of the Medical Internal Radiation Dose Committee of the Society of Nuclear Medicine, new phantom models for heart walls and heart chambers have been developed. Estimates and methods of calculations for specific absorbed fractions to 21 target organs are included for photon sources in the heart. (DLS)

11618 **Scintillation camera.** Iwanaga, M.; Kakegawa, M.; Nishikawa, M.; Shouta, K. (to Tokyo Shibaura Electric Co Ltd (Japan)). US Patent 4,223,388. 16 Sep 1980. Filed date 4 Apr 1978. vp.

A scintillation camera which detects the radiation position of radiation and visualizes the corresponding position by an oscilloscope, comprises: a reference radiation source including a radiation

source and a radiation shielding member having a plurality of through-holes arranged in a matrix; a first memory for storing a picture of a reference radiation source during a calibrating mode in dependence on position signals of radiation radiated from the reference radiation source; an arithmetic unit for computing the correcting amount at each cross point in a given matrix in dependence on a departure of the position of each hole of the radiation shielding member in the picture stored in the first memory from the correct position of the corresponding hole of the actual radiation shielding member; a second memory for storing the correcting amounts at the respective cross points of the given matrix from the arithmetic unit; a correction amount calculation circuit which reads out the correcting amounts at cross points of the given matrix which are stored in the second memory and close to the position signal of a radiation to be actually measured during a measuring mode to calculate the correcting amount of the position of the radiation to be actually measured; and adding circuit for adding the correcting amounts of the position signal of the radiation to be actually measured from the correcting amount calculation circuit to the position signal from a position calculation circuit.

11619 **Radiography.** Gollifer, M.J.; Hounsfield, G.N. (to EMI Ltd (United Kingdom)). US Patent 4,223,384. 16 Sep 1980. Filed date 29 Jun 1977. vp.

In a computerised tomographic (Cat) x-ray apparatus passage of the radiation through high absorption (Bone) regions can change a characteristic of the radiation, such as its frequency spectrum. This can introduce error into the final representation. Correction is provided by computing a first representation, identifying areas of bone and then determining corrections for those areas which can be used to provide a subsequent move accurate representation. Errors caused by scattering can also be compensated in this way.

11620 **Tomographic scanner with cadmium tungstate scintillation crystals.** Carlson, R.W.; Jagatich, C.T. (to Ohio Nuclear Inc). US Patent 4,220,860. 2 Sep 1980. Filed date 24 Jul 1978. vp.

A radiation detector suitable for use in tomographic scanners comprising at least one cadmium tungstate scintillation crystal optically coupled with a silicon photodiode or other photoelectric transducers. A plurality of cadmium tungstate crystals may be coupled to one silicon photodiode with fiber optic light guides. In a tomographic scanner, radiation passing through the scan circle impinges on the cadmium tungstate crystals causing them to scintillate. The light scintillated strikes the area of the p-n junction of the photodiode causing the photoelectric effect to be manifested. The intensity of radiation striking the crystal is determined by measuring the photoconductive conductance, photoemissive current or photovoltaic potential. From these intensities an image is computed of the radiation attenuation in the examined scan circle.

11621 **Gamma camera tomography apparatus.** Colombo, S.; Terra, L. (to Selo Societa Electtronica Lombarda Spa (Italy)). US Patent 4,220,861. 2 Sep 1980. Filed date 20 Apr 1978. vp.

This invention relates to a gamma camera tomography apparatus. According to the invention, an apparatus for making tomographic or normal surveys by means of a gamma camera comprises a base frame, which rotatably supports a discoidal member of horizontal axis, on which an articulation support for a survey head containing a gamma camera is radially mobile. Said discoidal member comprises a central hole, through which the body of a patient supported on a sliding bed is able to pass. There are provided motor means for rotating the discoidal member for radially moving the head support.

11622 **Data channel multiplexing system for ct scanner with rotating source.** Mcbride, T.R.; McCarthy, R.H.; Wake, R.H. (to Ohio Nuclear Inc). US Patent 4,220,863. 2 Sep 1980. Filed date 1 Apr 1977. vp.

A ct scanner has an outer circular array of stationary radiation detectors for an inner concentrically revolving source of radiation emitted in a fan pattern subtending a number of the detectors. A number of analog signal processing channels equal to the maximum number of subtended detectors at any given time is automatically connected via switching circuitry to receive the outputs of only the detectors within the fan pattern.

11623 **Electron applicator.** Symmons, E. B.; Taumann, L. (to Siemens Ag (Germany)). US Patent 4,220,866. 2 Sep 1980. Filed date 21 Jan 1978. vp.

In the illustrated embodiment, an electron collimator is to be mounted on the accessory holder of an electron accelerator. In radiation therapy, the down beam end of the applicator is to contact the patient to establish a precise spacing of the electron source therefrom. The legs of the l-shaped collimator plates have rods secured to the corner part thereof which link pairs of overlapping legs to a common carrier for joint lateral adjustment toward and away from the beam axis. The rods slide in apertures in the carrier as the legs are adjusted longitudinally. Cornered wall elements are secured to each collimator plate and overlap each other to surround the beam path, and have in-turned closely overlapping edges which terminate flush with the inner margins of the collimator plates so as to provide further electron collimation and to provide an essentially smooth patient contacting end face.

11624 **High ionic strength: its significance in immunosurveillance against tumor cells in sharks and rays (elasmobranchs).** Rosen, P.; Woodhead, A.D. (Brookhaven National Lab., Upton, NY). *Medical Hypotheses ;* 6: 441-446(1980).

It is postulated that the rarity of tumors in elasmobranchs is due to the high ionic strength in their tissues, which is equivalent to a high body temperature. Such conditions could lead to the elimination of variable antigenicity and 100% immune surveillance. The basis for this theory is that the repressor molecule for mitosis, not binding to its operator site cannot bind anywhere.

5507 Microbiology

11625 **(DP-MS—80-107) Measure of Legionella pneumophila activity in situ.** Fliermans, C.B.; Soracco, R.J.; Pope, D.H. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.; Rensselaer Polytechnic Inst., Troy, NY (USA)). 1981. Contract AC09-76SR00001. 22p. (CONF-810313—1). NTIS, PC A02/MF A01.

From American Society of Microbiology meeting; Dallas, TX, USA (3 Mar 1981).

Detection of Legionella pneumophila by serogroup-specific fluorescent antibodies was combined with a tetrazolium dye (INT) to measure electron transport activity. The biological uptake and reduction of the INT dye was studied in pure cultures and in natural water samples with respect to temperature. Uptake was complete within 60 minutes. Controls inhibited with formaldehyde demonstrated little activity. Both the in vitro and in situ determinations suggested that the electron transport system of Legionella was active over a temperature range of 25° to 60°C.

11626 **Assembly of viral membranes.** Snipes, W.; Keith, A.D. pp 109-126 of Light transducing membranes. Univ. Park, PA; Academic Press, Inc. (1978).

A large number of viruses, including animal, plant, and bacterial viruses, contain a lipid bilayer as a structural component of the virion. In most cases the bilayer exists as part of a membrane envelope surrounding an inner core, or nucleocapsid. this viral envelope has many characteristics similar to those of other membrane structures, such as lipid-protein composition, membrane fluidity properties, and a typical trilaminar appearance in electron micrographs. There is considerable variety in the mechanisms whereby different viruses assemble their membrane structures. The enveloped viruses mature by a budding process in which a portion of cellular membrane encloses the nucleocapsid. Some viruses bud through the cytoplasmic membrane or into vacuoles while others bud through the nuclear membrane. Others are assembled in the cytoplasm and apparently have no association with cell membrane structures. Of the two lipid containing bacterial viruses that have been studied extensively, PM2 appears to mature near the inner surface of the cytoplasmic membrane, while phi 6 assembly apparently takes place in the center of the cell. Selected examples of the self-assembly of viral membrane structure are discussed in this review. (RJC)

11627 **Binding of fluorine-18 by the oral bacterium, Streptococcus mutans.** Yotis, W.W.; Mante, S.; Brennan, P.C.; Kirchner, F.R.; Glendenin, L.E. (Loyola Univ. Stritch School of Medicine, Maywood, IL). *Archives of Oral Biology ;* **24**: 853-860(1979).

The binding of carrier-free fluorine-18 by resting cells of the cariogenic microorganism Streptococcus mutans GS-5 was assessed. A Ge(Li)γ-ray spectrometer attached to a 4096 channel pulse-height analyzer was used to measure the ^{18}F bound and to check the radiochemical purity of ^{18}F. The binding was dependent on time, pH, the amount of ^{18}F used, the cell status and the fluoride concentration. The adherence of ^{18}F to Strep. mutans did not require addition of an exogenous energy source, such as glucose, and proceeded equally well at 4 to 37°C or at varying oxygen tensions. Under optimal conditions, resting cells of the strain bound approximately 10^9 atoms of ^{18}F and more than 10^{13} atoms of total fluoride in the presence of 10 parts/10^6 NaF per mg dry weight of cells that were not removed by repeated washings.

5508 Morphology

11628 **Blooms of surf-zone diatoms along the coast of the Olympic Peninsula, Washington. XII. The clay coat of Chaetoceros armatum T. West.** Lewin, J. (Univ. of Washington, Seattle); Colvin, J.R.; McDonald, K.L. *Botanica Marina ;* **23**: 333-341(1980).

Cell filaments of the surf diatom species Chaetoceros armatum T. West collected in the natural habitat were always surrounded with a coat of clay particles. Cell filaments grown in laboratory cultures had sticky surfaces and formed a coat of clay particles, when clays were suspended in the culture medium. Clay coats surrounding the frustules retained their integrity after exposure to hot concentrated acids, indicating an acid-resistant cementing material. Scanning electron microscopy (SEM) gave no evidence of any organic fibrillar material on the cell surfaces. Transmission electron microscopy (TEM) of cell sections revealed two morphological features considered relevant to the clay coat phenomenon: (1) a valve flange (siliceous extension near the margin of the valve), which appeared to retard collapse of the clay coat into apertures between the cells, and (2) a layer of organic material lying beneath the silicified frustule and exterior to the plasmalemma; microfibrils released from this organic layer appeared to pass to the outside through the opening between the valve and the first girdle band in the region of the bases of the setae. The chemical nature of the organic layer and the cementing substance remain unknown.

5509 Pathology

REFER ALSO TO CITATION(S) 11630

11629 **Surface morphology of Trichinella spiralis by scanning electron microscopy.** Kim, C.W. (State Univ. of New York, Stony Brook); Ledbetter, M.C. *Journal of Parasitology, The ;* **66**: No. 1, 75-81(Feb 1980).

The surface morphology of larval and adult Trichinella spiralis was studied by scanning electron microscopy (SEM) of fixed, dried, and metal-coated specimens. The results are compared with those found earlier by various investigators using light and transmission electron microscopy. Some morphological features reported here are revealed uniquely by SEM. These include the pores of the cephalic sense organs, the character of secondary cuticular folds, variations of the hypodermal gland cell openings or pores, and the presence of particles on the copulatory bell.

5510 Physiological Systems

11630 **(DOE/EV/03264—19) Inborn anemias in mice. Progress report, 1 August 1979-15 July 1980.** Bernstein, S.E.; Russell, E.S. (Jackson Lab., Bar Harbor, ME (USA)). 1 Aug 1980. Contract AS02-76EV03264. 22p. NTIS, PC A02/MF A01.

Four macrocytic anemias, four hemolytic anemias, nonhemolytic microcytic anemia, transitory siderocytic anemia, sex-linked iron-transport anemia, an α-thalassemia, and a new target-cell anemia are under investigation in mice. Each of these blood dyscrasias is caused by the action of a unique mutant gene, which determines the structure of different intracellular molecules, and thus controls a different metabolic process. Thus the wide range of different hereditary anemias has considerable potential for uncovering many different aspects of hemopoietic homeostatic mechanisms in the mouse. Each anemia is studied through: (a) characterization of peripheral blood values; (b) determinations of radiosensitivity under a variety of conditions; (c) measurements of iron metabolism and heme synthesis; (d) histological and biochemical study of blood-forming tissue; (e) functional tests of the stem cell component; (f) examination of responses to erythroid stimuli; and (g) transplantation of tissue between individuals of differently affected genotypes.

5520 Public Health

REFER ALSO TO CITATION(S) 11650, 11655, 11656, 11657

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 11189

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 10390, 10395, 10396, 11501, 11600, 11670, 11679, 11686

11631 **(AD—465292) Medical examination of Rongelap people six months after exposure to fallout.** Bond, V.P.; Conard, R.A.; Robertson, J.S.; Weden, E.A. Jr. (Naval Medical Research Inst., Bethesda, MD (USA)). Apr 1955. 46p. NTIS, PC A03/MF A01.

Follow-up medical examinations were made of the Marshallese inhabitants of Rongelap Atoll 6 months after they had been exposed to atomic bomb fallout radiation during the Operation CASTLE test series in March, 1954. During the early acute period following exposure, these people had shown systemic effects and marked hematological changes resulting from penetrating gamma radiation; extensive superficial skin lesions and epilation associated principally with beta and soft gamma radiation from fallout material deposited on uncovered skin areas; and minimal internal contamination with fission products, resulting principally from ingestion of fallout material. At the time of the 6-month resurvey the individuals, in general, appeared healthy and normally active, and no deaths had occurred in the interim period. Chest X-rays of all individuals revealed no abnormalities ascribable to the fallout radiation. Analysis of hematological data obtained failed to demonstrate a significant effect of measles on the peripheral blood count. Neutrophile, lymphocyte, and platelet counts were not significantly different from counts taken on the 74th post-exposure day, and none of these values had returned to control levels.

11632 **(AD-A—086083) Army medical research and development technical report. Annual progress report 1 Oct 78-30 Sep 79.** (Armed Forces Inst. of Pathology, Washington, DC (USA)). 1 Oct 1979. 9p. NTIS, PC A02/MF A01.

The research project reported in this Progress Report is as follows -- Project: Lesions in Animals Fed Enzyme Inactivated Frozen and Irradiated Meats.

11633 **(AD-A—086447) Immunological approach in schistosomiasis. Annual report.** Hassan, F.; Seddik, S.; Shetta, A.; Nousseir, A. (Egyptian Organization for Biological and Vaccine Production (Agouza), Cairo). Jun 1979. 22p. NTIS, MF A01.

Study No. 1 with reference to our last report of 1978 immunization experiments with high doses of irradiation with Cobalt 60 are terminated and the study with its results are as follows. In a previous study a trial of inducing protection by Immunization of mice with low doses of cobalt 60 irradiated cercariae was carried

out. The results were rather encouraging yet follow up of immunized animals failed to give satisfactory resistance to new infection.

11634 **(DOE/EV/72002—48) Pollen genetic markers for detection of mutagens in the environment.** Nilan, R.A.; Rosichan, J.L.; Arenaz, P.; Hodgdon, A.L.; Kleinhofs, A. (Washington State Univ., Pullman (USA). Dept. of Agronomy and Soils). 1980. Contract AT06-76EV72002. 24p. (CONF-8005134—1). NTIS, PC A02/MF A01.

From Conference on pollen systems to detect biological activity of environmental pollutants; Knoxville, TN, USA (6 May 1980).

To utilize and exploit pollen for in situ mutagen monitoring, screening and toxicology, the range of genetic traits in pollen must be identified and analyzed. To be useful for the development of mutagen detection systems proteins should be: (1) activity stainable or immunologically identifiable in the pollen, (2) the products of one to three loci; and (3) gametophytic and nuclear in origin. Several proteins, including alcohol dehydrogenase in maize, which meet these criteria are discussed. The waxy locus in barley and maize which controls starch deposition for pollen screening and mutant detection. Thirty waxy mutant lines, induced by sodium azide and gamma-rays are characterized for spontaneous and induced reversion frequencies, allelism, karyotype, amylose content, and UDPglucose glucosyltransferase (waxy gene product) activity. Twelve mutant alleles are being mapped by recombinant frequencies.

11635 **(LA—8577-PR) Biomedical and Environmental Research Program of the LASL Life Sciences and Health Divisions. Progress report, January-December 1979.** Petersen, D.F. (comp.). (Los Alamos Scientific Lab., NM (USA)). Oct 1980. Contract W-7405-ENG-36. 150p. NTIS, PC A07/MF A01.

Nine separate abstracts were prepared for the research papers presented by the Life Sciences Division and by the Health Division. This report summarizes research and development activities of LASL's Biomedical and Environmental Research Program for the calendar year 1978. (KRM)

11636 (LA—8577-PR, pp 1-20) **Toxicology Group (LS-1).** Oct 1980.

In Biomedical and Environmental Research Program of the LASL Life Sciences and Health Divisions. Progress report, January-December 1979.

These studies of the toxicology group focus on 2 major areas. The first of these, the lung tumorigenesis program, is designed to delineate the role of internally-deposited radiation in carcinogenesis of the resiratory tract. A second program is assigned the task of assessing health effects associated with various materials generated during production of shale oil. Inhalation studies are concerned with effects of particulates such as raw and spent shales, while a second approach examines the effects of liquid products applied directly to the skin of mice as a measure of relative carcinogenicity. The goal of the immunology program is to delineate the immunological events which are altered during conversion to the neoplastic state. Initial model studies have focused on alterations in immune profile in rats given 3-methylcholanthrene, a potent chemical carcinogen. The information gathered with model systems will be utilized to design programs for monitoring immunological changes in animals enrolled in the lung tumorigenesis, oil shale toxicology and the manmade fibers project. The cultured cell project focuses on pollutant-induced alterations in metabolism at the cellular level.

11637 (LA—8577-PR, pp 118-129) **H-14 Epidemiology Group.** Oct 1980.

In Biomedical and Environmental Research Program of the LASL Life Sciences and Health Divisions. Progress report, January-December 1979.

The purpose of the Epidemiology Group is to perform research related to human health studies with particular reference to plutonium. The plutonium in tissues has been a continuing study of autopsy samples to determine the content of plutonium in the general population from fallout and in workers who have had occupational exposures. The human health studies of plutonium workers have shown an increasing rate of progress as funding and staffing have increased in the past year.

11638 **BEIR-III report: origin of the controversy.** Fabrikant, J.I. (Univ. of California, San Francisco). Contract W-7405-ENG-48. *American Journal of Roentgenology ;* **136**: No. 1, 209-214(Jan 1981).

This commentary gives a general background into the controversy that arose during the preparation of the current Report of the Committee on the Biological Effects of Ionizing Radiation (the BEIR-III Report). The major goals of the BEIR III report are outlined and several types of dose-response models for radiation carcinogenesis are discussed. The remainder of the paper deals with estimation of the carcinogenic risk in humans of low level radiation - the major source of controversy. Finally, the implications of numerical risk estimation for radiation protection and public health policy are discussed. (KRM)

11639 **BEIR III controversy.** Fabrikant, J.I. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Radiation Research ;* **84**: No. 3, 361-368(Dec 1980).

This paper gives a general background to a controversy that arose during the preparation of the report of the Advisory Committee on the Biological Effects of Ionizing Radiation of the National Academy of Sciences-National Research Council (the BEIR III Report). It briefly covers what is known and what is not known about the health effects of low-level radiation and why the controversy centers on low-level, low LET radiation. The disagreements center not on the scientific facts and not on the existing epidemiological or experimental data, but rather on the assumptions, interpretations and analyses of the available facts and data. (KRM).

11640 **Comments on the somatic effects section of the BEIR III report.** Rossi, H.H. (Columbia Univ. College of Physicians and Surgeons, NY). Contract DE-AC02-78EV04733. *Radiation Research ;* **84**: No. 3, 395-406(Dec 1980).

The recent report of the BEIR Committee of the National Academy of Sciences presents a wide range of risk estimates for radiogenic cancer. The values that can be considered to be most plausible on the basis of radiobiological and epidemiological evidence are given little emphasis and they are presented as lower bounds of the probable risk. The upper bound is said to be provided by estimates based on the so-called linear hypothesis. The preferred analysis in BEIR III requires an arbitrary choice of a critical parameter. This results in estimates that differ little from those given in BEIR I and that may be too high by an order of magnitude. It also refuses to speculate on any health effects of background radiation. It thus does not support the validity of those concepts of radiation protection that are based on linearity.

11641 **Evidence for an unconventional radiosensitivity of rat 9L subcutaneous tumors.** Wallen, C.A.; Michaelson, S.M.; Wheeler, K.T. (Univ. of Rochester, NY). Contract DE-AC02-76EV03490. *Radiation Research ;* **84**: No. 3, 529-541(Dec 1980).

The cellular radiosensitivity of rat 9L subcutaneous (sc) tumors was determined by measuring cell survival with an in vivo to in vitro colony-forming assay. The radiosensitivity of 9L tumor cells did not vary with changes in tumor weight (0.03 to 2.0 g), appearance of necrosis, or the use of anesthesia. However, the composite survival curve showed a sensitivity (D_0 = 3.6 Gy) intermediate between and statistically different from that observed either for exponential cells from monolayer cultures (D_0 = 1.8 Gy) or single cells from dissociated tumors (D_0 = 2.1 Gy), and tumor cells from N_2-asphyxiated rats (D_0 = 5.3 Gy). This study indicates that either perfusion-limited hypoxia or more probably cellular recovery is the major contributor to the observed intermediate cellular radiosensitivity of 9L sc tumors.

11642 **Technique of neutron-induced (fission-track) autoradiography with histological detail.** Smith, J.M.; Taylor, G.N.; Jee, W.S.S. (Univ. of Utah College of Medicine, Salt Lake City). Contract EY-76-C-02-0119. *Radiation Research ;* **84**: No. 3, 579-585(Dec 1980).

The primary advantage of neutron-induced or fission-track autoradiography compared with conventional autoradiography is that for low concentrations of fissile nuclides prohibitively long exposure times may be avoided. However, it is difficult to produce

imaging of biological structures on the neutron-induced autoradiograph which would allow localization of the nuclide histologically. The technique presented circumvents this difficulty using a thin polycarbonate film applied to the histologically stained tissue section mounted on a quartz substrate. After irradiation of the tissue section with an appropriate thermal neutron flux, the fission fragment tracks are revealed by etching the film with KOH. The tracks, superimposed on the stained tissue, may be observed under the light microscope in the same manner as for conventional nuclear emulsion autoradiography.

11643 **Evidence for repair of premutational damage from split x-ray doses.** Jostes, R.F. Jr.; Painter, R.B. (Univ. of California, San Francisco). *Radiation Research ;* **84**: No. 3, 586-590(Dec 1980).

Chinese hamster ovary cells were given two 450-rad doses of X rays separated by 1 or 2 h, during which the cells were held at room temperature to minimize progression through the cell cycle. The frequency of induced mutations to 6-thioguanine resistance was compared with that of mutations induced by a single dose of 450 or 900 rad. Mutation frequencies induced by the split dose were intermediate between those induced by the two single doses, suggesting that premutational lesions were repaired.

11644 **Pathologic effects of intracavitary irradiation with californium-252.** Sullivan, M.F. (Battelle Pacific Northwest Labs., Richland, WA); Beamer, J.L.; Cross, F.T.; Lund, J.E.; Mahony, T.D.; Endres, G.W.; Buschbom, R.L. Contract DE-AC06-76RLO-1830. *International Journal of Radiation Oncology, Biology and Physics ;* **6**: No. 12, 1613-1627(Dec 1980).

The effect of exposures of miniature swine to ^{252}Cf afterloading tubes placed in the cervix uteri with a tandem applicator were compared with those effects resulting from ^{226}Ra sources. Dosimetry for the adjacent normal tissues was established by surgically attaching termolumuniscent dosimeters (TLDs) at the various sites, as well as by theoretical calculation. Changes were observed in the rectum, urinary bladder, ureters and cervix as both early, $<$ 75 days, and late, $>$ 75 days, consequences of exposure. Changes in the rectum, urinary bladder and uterine cervix at risk in radiotherapy were used to calculate RBEs for both early and late complications. The overall value for early fibrosis was 4.34 +- 0.41. For late fibrosis the overall value was 6.73 +- 0.43, indicating that the repair potential of these tissues is not as good after neutron exposure. RBEs for vasculitis and muscle degeneration were similar.

11645 **Clinical trial for advanced cervico-vaginal pelvic carcinomas using californium CF-252 fast neutron therapy: report of early responses.** Maruyama, Y.; Yoneda, J.; Krolikiewicz, H. (Univ. of Kentucky Medical Center, Lexington). *International Journal of Radiation Oncology, Biology and Physics ;* **6**: No. 12, 1629-1637(Dec 1980).

This report summarizes clinical experiences with californium (Cf) 252 for the radiotherapy of advanced cervico-vaginal carcinomas at the University of Kentucky Medical Center from November 1976 to April 1979. Fifty-nine patients were treated with Cf-252 during this period. After pilot studies, a treatment schedule was developed which appeared to offer improved local control and clearance of these tumors in $\sim$ 90% of treated patients. Ultimate long term survival and outcome will depend upon the frequency of control of local-regional disease and the frequency of appearance of more disseminated and metastatic disease. Cf-252 neutron brachytherapy was combined with 4500 to 5500 rad of Cobalt 60 or linear accelerator external beam fractionated radiotherapy for 4 to 6 weeks. Neutron treated patients whose disease was in appropriate clinical stages were also treated with combined radiotherapy-surgery without problems. All histological patterns responded, and no unusual severe or unanticipated early side effects or toxic tissue reactions were observed.

11646 **Effect of fractionated doses of pions on normal tissues. Part I. Mouse skin.** Raju, M.R. (Los Alamos Scientific Lab., NM); Carpenter, S.; Tokita, N.; DiCello, J.F.; Jackson, D.; Froehlick, E.; Von Essen, C. *International Journal of Radiation Oncology, Biology and Physics ;* **6**: No. 12, 1663-1666(Dec 1980).

The relative biological effectiveness (RBE) of pions compared to X rays on mouse skin was measured for one, two and five daily fractions. Normal mouse skin recovery between fractions was determined to be considerably reduced for pions as compared to X rays. The RBE of pions based on acute skin reaction scoring was estimated to be approximately 1.1, 1.3, and 1.45 for one, two and five daily fractions, respectively.

11647 **Use of 5-Bromodeoxyuridine and irradiation for the estimation of the myoblast and myocyte content of primary rat heart cell cultures.** Masse, M.J.O.; Harary, I. (Univ. of California, Los Angeles). Contract EY-76-C-03-0012. *Journal of Cellular Physiology (Formerly Journal of Cellular and Comparative Physiology) ;* **105**: No. 2, 197-207(Nov 1980).

A method for killing dividing cells was adapted for the elimination of dividing heart muscle cells (myoblasts) in cultures. We have used this method to demonstrate their presence and to estimate their number as well as the number of nondividing heart muscle cells (myocytes) in the neo-natal rat heart. Cells were cultivated in BUdR (5-bromodeoxyuridine) 10^{-4} M for 3 days and then irradiated with long uv light. The selective elimination of dividing cells led to a loss of myosin Ca^{2+}-activated ATPase in the cultures. The percent of ATPase left after irradiation was 32% of the control in cultures derived from 1-day postnatal rats and 48% in cultures from 4-day postnatal rats. This reflects an in vivo shift of myoblasts to myocytes in the muscle cell population as the rat ages.

11648 **Radioactive phosphorus uptake test: an in vitro analysis of choroidal melanoma and ocular tissues.** Packer, S.; Shields, J.A.; Christman, D.R.; Wolf, A.P.; Atkins, H.L. (Brookhaven National Lab., Upton, NY). *Investigative Ophthalmology and Visual Science ;* **19**: No. 4, 386-392(Apr 1980).

The concentration of radioactive phosphorus in uveal melanoma and normal parts of the eye was determined in vitro in 14 eyes. The eyes were enucleated after a positive ^{32}P uptake test. Portions of the melanoma as well as normal choroid, retina, sclera, lens, and vitreous were analyzed. The ^{32}P uptake test had been performed at various intervals after intravenous administration of ^{32}P from 24 to 556 hr. The in vitro uptake of ^{32}P was compared to cell type, tumor volume, time of testing, percent uptake measured clinically, and specific activity. The only positive correlation was between percent uptake measured clinically and ^{32}P concentration (dpm/gm). A higher concentration of phosphorus in melanoma resulted when carrier-free ^{32}P was used. A negative correlation existed between number of hours from injection to clinical measurement of percent uptake, although melanoma to normal choroid ratios did not change from 24 to 72 hr. No correlation was found between uptake and tumor volume. The sample was small; however, we saw no correlation between ^{32}P uptake and degree of malignancy.

11649 **Total-body irradiation: a historical review and follow-up.** Lushbaugh, C.C.; Fry, S.A.; Huebner, K.F.; Ricks, R.C. (Oak Ridge Associated Universities, TN). pp 3-5 of Medical basis for radiation accident preparedness. Hubner, K.F.; Fry, S.A. (eds.). New York, NY; Elsevier North Holland, Inc. (1980).

From Radiation accident preparedness conference; Oak Ridge, TN, USA (19 Oct 1979).

The authors present a historical review of radiation accidents and categorize these accidents by type of exposure, chronological order, place, and numbers of persons exposed. Also included are lists of medical personnel involved in treatment for these radiation accidents. (DLS)

11650 **Follow-up studies over a 25-year period on the Japanese fishermen exposed to radioactive fallout in 1954.** Kumatori, T. (National Inst. of Radiological Sciences, Chibaa-shi, Japan); Ishihara, T.; Hirashima, K.; Sugiyama, H.; Ishii, S.; Miyoshi, K. pp 33-54 of Medical basis for radiation accident preparedness. Huebner, K.F.; Fry, S.A. (eds.). New York, NY; Elsevier North Holland, Inc. (1980).

From Radiation accident preparedness conference; Oak Ridge, TN, USA (19 Oct 1979).

Medical surveillance of Japanese fisherman exposed to fallout from a thermonuclear test explosion in 1954 is reported for a

twenty-five year period. Internal and external dose estimates are discussed in light of radiochemical analysis of urine, thyroid glands, and organs of fatal cases along with medical records of biological radiation effects to skin, hematological system, bone marrow, spermatocytes, eyes, thyroid, and liver. (DLS)

11651 **Dosimetry studies for an industrial radiography accident.** Holly, F.E. (Univ. of California, Los Angeles); Beck, W.L. pp 265-277 of Medical basis for radiation accident preparedness. Huebner, K.F.; Fry, S.A. (eds.). New York, NY; Elsevier North Holland, Inc. (1980).

From Radiation accident preparedness conference; Oak Ridge, TN, USA (19 Oct 1979).

On 5 June 1979, an industrial worker who was not involved with radiography found an ^{192}Ir source that had accidently become detached and lost from its shielded camera. He placed the source in the hip pocket of his coveralls and returned to work, keeping the ^{192}Ir source for some time before taking it to the plant manager. The biophysical calculations for the determination of exposure and depth-dose calculations are the basis for this paper. (DLS)

11652 **1976 Hanford americium accident.** Heid, K.R. (Battelle Pacific Northwest Labs., Richland, WA); Breitenstein, B.D.; Palmer, H.E.; McMurray, B.J.; Wald, N. pp 345-355 of Medical basis for radiation accident preparedness. Huebner, K.F.; Fry, S.A. (eds.). New York, NY; Elsevier North Holland, Inc. (1980).

From Radiation accident preparedness conference; Oak Ridge, TN, USA (19 Oct 1979).

A 64-year-old nuclear chemical operator was injured by a chemical explosion of an ion exchange column used for americium recovery. He was heavily externally contaminated with americium and inhaled a significant quantity. His medical course; including DTPA treatments, biochemical analysis, and radioisotope dosimetry, is the basis of this paper. (DLS)

11653 **In vitro human cytogenetic dose-response systems.** DuFrain, R.J.; Littlefield, L.G.; Joiner, E.E.; Frome, E.L. (Oak Ridge Associated Universities, TN). pp 357-374 of Medical basis for radiation accident preparedness. Huebner, K.F.; Fry, S.A. (eds.). New York, NY; Elsevier North Holland, Inc. (1980).

From Radiation accident preparedness conference; Oak Ridge, TN, USA (19 Oct 1979).

To provide dosimetry for radiation accident management, in vitro dose-response models are used for deriving biological estimates of the doses received by individuals involved in accidents. The dose estimates are made by comparing the frequency of specific cytogenetic aberrations in cultured blood lymphocytes of the exposed person with the frequency observed in human lymphocytes irradiated in vitro. Three factors influenced the accuracy of the in vitro dose-response relation determinations. These are the biological aspects of lymphocytes and the culture system, statistical and mathematical aspects of data collection and analysis, and the physical conditions of the in vitro radiation exposure. Each of these factors is discussed and examples of dose-response curves generated for needs of dose-determination in accidents involving americium 241 and iridium 192. (DLS)

11654 **Cytogenetic dose estimates from in vivo samples from persons involved in real or suspected radiation exposures.** Littlefield, L.G.; Joiner, E.E.; DeFrain, R.J.; Huebner, K.F.; Beck, W.L. (Oak Ridge Associated Universities, TN). pp 375-390 of Medical basis for radiation accident preparedness. Huebner, K.F.; Fry, S.A. (eds.). New York, NY; Elsevier North Holland, Inc. (1980).

From Radiation accident preparedness conference; Oak Ridge, TN, USA (19 Oct 1979).

The application of cytogenetic techniques in evaluations of persons referred to REAC/TS has confirmed the usefulness of this method in biological dose estimation and in providing information relative to the nature of the radiation exposure. Findings from in vivo dose-responses of lymphocytes verify that cytogenetic evidence of radiation exposure can be obtained from evaluating cultured lymphocytes from persons having measurable body burdens of α-emitting transuranics, and suggest that the induction of multiple lesions is a characteristic finding in human lymphocytes exposed to alpha radiation. (DLS)

11655 **Long-range studies of uranium workers and the Oak Ridge radiation worker population.** Polednak, A.P. (Oak Ridge Associated Universities, TN). pp 401-409 of Medical basis for radiation accident preparedness. Huebner, K.F.; Fry, S.A. (eds.). New York, NY; Elsevier North Holland, Inc. (1980).

From Radiation accident preparedness conference; Oak Ridge, TN, USA (19 Oct 1979).

The Epidemiology Group at Oak Ridge Associated Universities is concerned mainly with examining associations between occupational radiation exposure and subsequent mortality. Various chemical toxicants are also under investigation for their radiosensitivity effects in studies of the long-term radiation exposure on health. Ongoing studies are concerned with evaluating the mortality experience of past and present workers at Oak Ridge nuclear facilities. (DLS)

11656 **Continuing study of mortality in Hanford workers.** Marks, S.; Gilbert, E.S. (Pacific Northwest Labs., Richland, WA). pp 411-417 of Medical basis for radiation accident preparedness. Huebner, K.F.; Fry, S.A. (eds.). New York, NY; Elsevier North Holland, Inc. (1980).

From Radiation accident preparedness conference; Oak Ridge, TN, USA (19 Oct 1979).

Presented is an updated analysis of data on the mortality experience of about 12,500 white, male workers who were employed at Hanford for at least two years. Using a Mantel-Haenszel analysis of trend of mortality with radiation dose, a positive trend of multiple myeloma with increasing dose at the 1% level of significance remains. All deaths and all cancer deaths display a similar negative trend with dose. (DLS)

11657 **Long-term follow-up of radium dial painters and thorium workers.** Brues, A.M. (Argonne National Lab., IL). pp 441-450 of Medical basis for radiation accident preparedness. Huebner, K.F.; Fry, S.A. (eds.). New York, NY; Elsevier North Holland, Inc. (1980).

From Radiation accident preparedness conference; Oak Ridge, TN, USA (19 Oct 1979).

A historical review and epidemiological follow-up of the long-term effects of radiation exposure are presented for radium dial painters and workers in a throium refinery. Special attention is paid to the form of radium exposure to dial painters and incidences of neoplasia in the workers. (DLS)

11658 **United States radiation accident and other registries of the REAC/TS Registry System: their functions and current status.** Fry, S.A. (Oak Ridge Associated Universities, TN). pp 451-468 of Medical basis for radiation accident preparedness. Huebner, K.F.; Fry, S.A. (eds.). New York, NY; Elsevier North Holland, Inc. (1980).

From Radiation accident preparedness conference; Oak Ridge, TN, USA (19 Oct 1979).

The organization, management, and functions of the REAC/TS Registry System for radiation accidents is presented. The United States Radiation Accident Registry, the Department of Energy Study, the DTPA Registry, and the Foreign Registry and follow-up programs of each are discussed. (DLS)

5602 Thermal Effects

11659 **Effect of temperature on carotenoid photoprotection in the copepod Diaptomus nevadensis.** Hairston, N.G. Jr. (Univ. of Rhode Island, Kingston). *Comparative Biochemistry and Physiology, A. Comparative Physiology ;* **62**: 445-448(1979).

Adult Diaptomus nevadensis containing large and small amounts of carotenoid pigment were exposed to 1.2 mW/cm^2 of visible blue light at 8 and 20°C. Darkly pigmented copepods survived significantly longer than lightly pigmented copepods at both temperatures. Copepods survived longer at 8°C than at 20°C, in contrast to the results reported by investigators studying carotenoid photoprotection in bacteria.

5603 Chemicals Metabolism And Toxicity

REFER ALSO TO CITATION(S) 10181, 11526, 11562, 11612, 11634, 11635, 11636, 11636, 11682, 11684

11660 **(ANL/AA—23) Projection of body burdens to assess the relative risk from exposure to trace elements from coal combustion emissions, drinking water, and diet.** Gasper, J.R.; Dauzvardis, P.A.; Surles T.G. (Argonne National Lab., IL (USA)). Dec 1979. Contract W-31-109-ENG-38. 26p. NTIS, PC A03/MF A01.

This study compares the relative health risk of exposure to seven trace elements from four sources - coal-fired electricity generation with a cold-side electrostatic precipitator, coal-fired electricity generation with a hot-side electrostatic precipitator, drinking water, and diet. The measure used for comparing health risks is body burden, which is the amount of an element accumulating within an exposed subject. Body burdens were used as a measure of risk because the lack of dose-response data restricts the projection of absolute risks of exposure, such as death or illness. Thus, projection of body burdens provides a measure of relative risk that can be used for comparison of impact potential from different sources of exposure. The assessment trace elements - arsenic, cadmium, chromium, nickel, lead, selenium, and zinc - were chosen to represent a range of physiological, environmental, and physical characteristics that affect the amount of accumulation. These factors include: toxicity, absorption, excretion, biological half life, bioaccumulation, biotransformation, volatility, and solubility.

11661 **(BNL—28789) Translocation and fate of sized man-made mineral fibers following exposure by intratracheal instillation or inhalation in rats.** Bernstein, D.M.; Drew, R.T.; Kuschner, M. (Brookhaven National Lab., Upton, NY (USA); State Univ. of New York, Stony Brook (USA). Health Science Center). 1980. Contract AC02-76CH00016. 18p. (CONF-8006151—1). NTIS, PC A02/MF A01.

From Environmental Protection Agency conference; Washington, DC, USA (14 Jun 1980).

A number of studies have suggested that both the length and diameter of glass fibers are important parameters in determining their deposition and translocation in the lung and in the subsequent pathological response by the lung. However, the fibers used in these studies had broad size distributions and were often administered in a highly artificial manner. To better characterize the biological response to glass fibers, a study is being conducted to determine the translocation and ultimate fate of fibers of defined sizes after introduction into the respiratory tract of rats by both instillation and inhalation. The fibers have geometric mean diameters of 1.5 μm (σ g = 1.11) and lengths of either 5 μm (σ g = 1.49) or 60 μm (σ g = 3.76). Serial sacrifices following intratracheal instillation of either 2 mg or 20 mg doses have shown differences in the response to the two sizes of fibers. The short fibers appear to lie primarily within mononuclear phagocytes in both the lung and lymph nodes. The majority of long fibers, however, cannot be totally engulfed by macrophages, nor are they cleared to the lymph nodes, although smaller fragments accompanying the long fibers may be so cleared. The long fibers produce a striking foreign body reaction in the lung, particularly when impacted in the bronchi. Significant numbers of long fibers, but few, if any, short fibers are found in the plural cavity. A trachea only inhalation method was used to expose rats to approximately 500 fibers/cc for one hour. Between 30,000 to 50,000 fibers were deposited in the lung of each rat.

11662 (CONF-800334—(Vol.1), pp 415-439) **Strategies for characterizing the fate of bioactive materials during coal liquefaction product upgrading.** Wilson, B.W. (Battelle Pacific Northwest Lab., Richland, WA); Craun, J.C.; Pelroy, R.A.; Petersen, M.R.; Felix, W.D. Jun 1980.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

An interdisciplinary strategy is outlined for characterizing the disposition of bioactive (toxic, teratogenic, mutagenic, and/or carcinogenic) materials in coal-derived hydrocarbon liquids during upgrading processing. Engineering input is required to select representative PDU and pilot-scale samples and appropriate processing schemes and conditions for upgrading experiments to ensure reliable extrapolation of results to demonstration and commercial-scale. Biology expertise is required to perform and interpret short-term in vitro cellular assays and whole-animal toxicity and carcinogenesis testing on raw and upgraded samples. Chemical separation and identification of active classes and components in the samples aids in interpreting bio-activity results and in quantifying effects of various upgrading processes and conditions. The end result will be a data base for reliably assessing and addressing potential occupational and environmental safety and health concerns associated with upgrading coal-derived liquids. An example of the value of this interdisciplinary approach is given by work performed on generically representative raw and hydrotreated SRC-II gas oil samples. Biological and chemical characterization indicates significant loss of bio-activity during hydrotreatment, with one postulated mechanism being removal of primary amine groups from multi-ring aromatic compounds.

11663 **(DOE/EV/04477—T2) Bioassay of polycyclic aromatic hydrocarbons.** Van Kirk, E.A. (Wyoming Univ., Laramie (USA)). Aug 1980. Contract AS02-77EV04477. 46p. NTIS, PC A03/MF A01.

Thesis.

A positive relationship was found between the photodynamic activity of 24 polycyclic aromatic hydrocarbons versus published results on the mutagenicity, carcinogenicity, and initiation of unscheduled DNA synthesis. Metabolic activation of benzo(a)pyrene resulted in detection of increased mutagenesis in Paramecium tetraurelia as found also in the Ames Salmonella assay. The utility of P. tetraurelia as a biological detector of hazardous polycyclic aromatic hydrocarbons is discussed.

11664 **Polynuclear aromatic hydrocarbons.** Jones, P.W.; Leber, P. (eds.). Ann Arbor, MI; Ann Arbor Science Publishers Inc. (1979). 919p. (CONF-781039—).

From 3. symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (Oct 1978).

Papers presented at the symposium are published in this volume. Significant advances in measurement methodology are reported with emphasis on high-performance liquid chromatography separation of PAH isomers. State-of-the-art analytical and sampling methods are discussed in addition to numerous studies of biological and chemical reactivity of PAH, their analogues and metabolites. The biologically oriented papers provide some of the most recent advances in the mechanistic exploration of metabolism of PAH and carcinogenesis. Separate abstracts of individual items are included in the Energy Data Base.

11665 (LA—8577-PR, pp 50-62) **Experimental Pathology Group (LS-4).** Oct 1980.

In Biomedical and Environmental Research Program of the LASL Life Sciences and Health Divisions. Progress report, January-December 1979.

In general, the projects pursued by the Experimental Pathology Group are projects that encompass both in vitro and in vivo approaches. Every project indludes whole animals as well as cell cultures or other experimental models. The projects are in four areas: studies of macrophage function, malignant progression, developmental defects, and chromosome abnormalities. The macrophage function studies are motivated by the desire to develop methods to assess damage from inhaled pollutants. The goal of the chromosome studies is to contribute to the detection methods and biological interpretation of substances that cause chromosome abnormalities. In addition, the programs in malignant progression and developmental defects both have considerable interest in the chromosome studies.

11666 (LA—8577-PR, pp 110-117) **Industrial Hygiene Group (H-5).** Oct 1980.

In Biomedical and Environmental Research Program of the LASL Life Sciences and Health Divisions. Progress report, January-December 1979.

The goal of the Industrial Hygiene Group is the evaluation and control of health hazards associated with the working environment. These include aerosol studies aimed at: (1) generating and characterizing aerosols for inhalation toxicology; (2) participating in industrial hygiene studies of oil shale technologies; (3) defining par-

ticle transport due to particle resuspension from surfaces; (4) development of remote sensing instrumentation; and (5) developing instrumentation for stack sampling.

11667 **(PB—80-184393) A research plan to study emissions from small internal combustion engines. Final report Sep 78-Sep 79.** Murrell, J.W. (Systems Research and Development Corp., Research Triangle Park, NC (USA)). Apr 1980. 129p. NTIS, PC A07/MF A01.

The report examines some of the requirements for investigating the environmental status of small internal combustion (IC) engines. These engines range in size from 1.5 to 15 hp and power a variety of equipment operated by homeowners and industry. With EPA's general growing concern of identifying sources of potentially carcinogenic emissions, a possibility exists that these small IC engines are a problem source. Research to characterize emissions from IC engines has largely been limited to critical pollutants, even though the small IC engine is an incomplete combustor. It follows that some carcinogens and other hazardous compounds are probable. The basic requirements addressed in the report include analytical equipment, experimental systems design, and statistical experimental design.

11668 **(PB—80-184914) Level 1 biological testing assessment and data formatting. Final report May 78-Jan 80.** Brusick, D.J. (Litton Bionetics, Inc., Kensington, MD (USA)). Apr 1980. Contract EPA-68-02-2681. 103p. NTIS, PC A06/MF A01.

The report gives results of an examination of data from three pilot studies including water effluent, fluidized-bed combustion, and coal gasification samples, using a scheme to compare health effects and ecological bioassay assessment data. The scheme is based on the assumption that each test method has a maximum dose (concentration) which can be reliably applied and that effects based on fractions of the maximum applicable dose (MAD) can be designated as degrees of toxicity. The levels of toxicity based on fractions of the MAD are given as high, moderate, low, and nondetectable (i.e., no effect detected at the MAD).

11669 **Studies of neoplastic development in respiratory tract epithelium.** Nettesheim, P. (Univ. of California, Los Angeles); Klein-Szanto, A.J.P.; Marchok, A.C.; Steele, V.E.; Terzaghi, M.; Topping, D.C. *Archives of Pathology and Laboratory Medicine ;* **105**: No. 1, 1-10(Jan 1981).

The dynamics of neoplastic development in conducting airways were studied in an animal model using morphologic and tissue culture techniques. Evidence for the regression of many metaplastic dysplastic lesions, including advanced preneoplastic lesions, was provided. The number of carcinogen-altered cells and the number of cells with neoplastic potential continued to increase as a function of time after carcinogen exposure. With the cell culture methods developed for these studies, it is possible to analyze qualitatively and quantitatively the progression of the neoplastic process as it takes place in vivo and to detect and enumerate the progenitor cells of later-appearing cancers. The investigations also provide strong evidence suggesting that carcinogen-exposed organs contain many more cells with neoplastic potential. This expression may, however, be sharply enhanced when permissive or promoting conditions prevail.

11670 **Interaction of dimethylbenzanthracene and diethylstilbestrol on mammary adenocarcinoma formation in female ACI rats.** Shellabarger, C.J. (Brookhaven National Lab., Upton, NY); McKnight, B.; Stone, J.P.; Holtzman, S. *Cancer Research ;* **40**: 1808-1811(Jun 1980).

It has been reported that x-irradiation and diethylstilbestrol (DES) act synergistically on mammary adenocarcinoma formation in female ACI rats. The physical carcinogen, x-irradiation, was replaced by a chemical carcinogen, dimethylbenzanthracene (DMBA), and their interaction was studied in this system. Thirty-three female ACI rats were given 13.3 mg of DMBA per 100 grams of body weight. A total of 10 mammary adenocarcinomas were found, 8 in rats with a single mammary adenocarcinoma and 2 in a single rat, over a 266-day study period. Twenty-nine rats were implanted with a cholesterol pellet containing 5 mg of DES, and a total of 47 mammary adenocarcinomas were found, 5 in rats with a single mammary adenocarcinoma and 42 in 5 rats with 2 or more mammary adenocarcinomas. Twenty-four rats were given a combined treatment of both compounds, DES 2 days before DMBA, and a total of 126 mammary adenocarcinomas were found, 2 in rats with a single mammary adenocarcinoma and 124 in 18 rats with 2 or more mammary adenocarcinomas. The interaction between DMBA and DES was interpreted to be synergistic in regard to the proportion of rats with one or more mammary adenocarcinomas, and the median times of appearance of both first and second mammary adenocarcinomas. These interactions between DMBA and DES resemble the previously reported synergistic interactions between radiation and DES on mammary adenocarcinoma formation in female ACI rats.

11671 **Studies on the relationships between induction of biotransformation and tumor-initiating activity of 7,12-dimethylbenz[a]anthracene in mouse skin.** DiGiovanni, J. (Univ. of Washington, Seattle); Berry, D.L.; Slaga, T.J.; Juchau, M.R. pp 553-568 of Polynuclear aromatic hydrocarbons. Jones, P.W.; Leber, P. (eds.). Ann Arbor, MI; Ann Arbor Science Publishers Inc. (1979).

From 3. symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (Oct 1978).

In this investigation, several potent inducers of microsomal mixed-function oxygenases were chosen as tools for studying the relationships between induction of biotransformation of DMBA in mouse skin and tumor initiation in the same tissue. The inducers utilized included 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), Aroclor 1254 and several closely related derivatives. We have used the two-stage system of mouse skin tumorigenesis extensively in these studies. As judged by HPLC profiles, the pattern of metabolite formation in mouse epidermal homogenates was quite similar regardless of the inducer utilized with the possible exception of TCDD. The order of inducing capacity was as follows: TCDD > DB[a,c]A > MC > DMBA > Aroclor 1254. TCDD and Aroclor 1254, at 2-μg and 100-μg topical doses per mouse, were only very weak tumor initiators in the skin. Pretreatment with TCDD and Aroclor 1254 effectively inhibited tumor initiation by DMBA. TCDD was extremely potent in this regard. In addition, pretreatment with TCDD effectively inhibited tumor initiation by B[a]P. The anticarcinogenic effects of TCDD and Aroclor 1254 appeared to correlate with the magnitude, as well as the time course, of induction of monooxygenase enzymes of the skin. Furthermore, the quantity of ^{3}H-DMBA bound to DNA and RNA (but not to protein) in the presence and absence of TCDD pretreatment correlated well with the tumor response under similar conditions. These experiments suggested that pretreatment with TCDD and Aroclor 1254 both resulted in increased rates of inactivation of DMEA and B[a]P relative to the rates of activation in mouse skin.

11672 **Comparative microbial and mammalian cell in vitro bioassay assessment of fossil fuel-generated respirable particulates.** Crowley, J.P.; Dennis, A.J.; Facklam, T.J.; Margard, W.L. (Battelle Columbus Labs., OH). pp 603-620 of Polynuclear aromatic hydrocarbons. Jones, P.W.; Leber, P. (eds.). Ann Arbor, MI; Ann Arbor Science Publishers Inc. (1979).

From 3. symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (Oct 1978).

In this study the biological effects of several different flyash particulates and aqueous extracts of thosee particulates in a regimen of microbial and mammalian cell system are reported. While negative microbial (Ames) mutation results were obtained, a battery of in vitro tests did identify two parent samples which contained water-soluble moieties having both cytotoxic and genetic toxicity potential. The variable results obtained in detecting DNA damage may be a reflection of mutagen specificity or inherent constraints present in the test systems. Observed activity of a particular compound may be due to related factors such as diffusion, membrane transport and protein binding which may vary in different test systems. Specifically, a noncomparable result between the E. coli PolA+A- assay and the WI-38 DNA repair assay may not be an indication of lack of activity. The effective dose or chemical configuration of components of complex mixtures at the nucleic acid level for these two widely varying cell types could be significantly different. Additionally, the mechanisms of these two processes vary greatly in complexity even though nucleic acid effects form the basis for the endpoint of both assays. Similar considerations apply

to the analysis of cytotoxicity data. It is theoretically possible that both synergistic and antagonistic chemical reactions occur in these complex environmental mixtures in the physiological environment. This again might alter the effects observed in one or more types of assays which would be sensitive to the compound modifications. Thus, it is mandatory that a spectrum of assays be applied for primary assessment of any complex environmental material. The results obtained from a primary screening profile may be applied in choosing further in vivo or in vitro test systems having specific endpoints in order to define multicellular exposure effects on subcellular mechanisms.

11673 **Effect of weak-, non- and co-carcinogenic chemicals on 2-acetylaminofluorene-induced mutation in Salmonella typhimurium.** Weeks, C.E.; Rao, T.K.; Young, J.A.; Slaga, T.J.; Epler, J.L. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Toxicology ;* **14**: 255-262(1979).

The effects of various weak-, non-, and co-carcinogenic chemicals on 2-acetylaminofluorene-induced mutation in Salmonella typhimurium were studied. We found that a single co-mutagen could provide for either enhanced or decreased mutagenesis. A differential effect on mutagenic expression was dependent upon: (1) the type of inducer of S-9 (supernatant from liver homogenate centrifuged at 9000 x g) liver enzymes; (2) the amount of S-9 enzyme preparation employed; and (3) the combined dose of mutagen plus co-mutagen studied. No effect was observed in the absence of S-9. Our data suggest that in S. typhimurium a primary factor in the alteration of mutagenesis by a combination of chemicals is changes in metabolism of the principal mutagen.

5604 Other Environmental Pollutant Effects

11674 **(AD-A—086468) Biological effects of nonionizing electromagnetic radiation. Volume IV. Number 4. Quarterly report Mar-Jun 80.** Kleinstein, B.H.; Dyner, S.A. (Franklin Research Center, Philadelphia, PA (USA). Science Information Services Organization). Jun 1980. 80p. NTIS, PC A05/MF A01.

This quarterly digest presents current awareness information on the biological effects of nonionizing electromagnetic radiation (microwave and radio frequency) in the range of 0 Hz to 100 GHz. The effects of magnetic and electric fields (static and alternating) are also covered. Each issue contains abstracts of English and foreign current literature, summaries of ongoing research investigations, news items, and a directory of meetings and conferences.

11675 **(AD-A—087039) Effect of infrared laser radiation on biological systems. Final report Mar 72-May 73.** Pratt, G.W. Jr. (Massachusetts Inst. of Tech., Cambridge (USA)). Jun 1973. 14p. NTIS, PC A02/MF A01.

A low power CO2 laser has been used to kill a spore preparation of Bacillus Subtilis. The CO2 laser has been found to be very effective in deactivating these spores. A 65 watt/sq cm beam reduced the dry live spore population by 3 orders of magnitude in 0.4 seconds as compared to a reduction by one order of magnitude after 60 seconds exposure (150 times as long) to pressurized steam at 130 C. A possible explanation of the high efficiency of laser sterilization may be deactivation by resonant absorption of infrared energy at 10.6 mu. Experiments discussing selected damage in proteins are presented.

11676 **(AD-A—087105) Laser Raman spectroscopy of ultraviolet-induced cataracts in rabbits and monkeys. Final report Sep 77-Feb 79.** Thomas, D.M.; Schepler, K.L. (School of Aerospace Medicine, Brooks AFB, TX (USA)). Dec 1979. 56p. NTIS, PC A04/MF A01.

The Raman spectra of normal rabbit and monkey lenses have been recorded over the range of 0-1/4000 cm. Spectral results indicate that protein conformation is predominantly beta-pleated sheet. Polarization measurements and assignments for most of the bands have been made; the spectral region for water indicates extensive hydrogen bonding. A nitrogen laser, operating at 337 nm, was used to produce cataracts in rabbit and monkey lenses; the Raman spectra of the cataractous lenses were also recorded. Spectral changes, observable in the water region, are correlated with a mechanism of ultraviolet cataractogenesis.

11677 **(AD-A—087269) Research on ganglion cell responses after laser exposure of the retina. Final report Jan 77-Dec 78.** Wolbarsht, M.L. (Duke Univ., Durham, NC (USA). Dept. of Ophthalmology). May 1980. 51p. NTIS, PC A04/MF A01.

Electrophysiological recordings were made from retinal ganglion cells in the macula (including fovea) of several species of Macaque monkeys. After exposure to high-intensity argon or HeNe lasers both above and below the lesion level, the receptive fields lacked a peripheral portion. This was accompanied by a slight increase in the central portion of the receptive field. Some quite large receptive fields were found around the fovea, often extending through it. The large receptive fields could also extend through the site of a laser lesion. No unsymmetrical changes in the receptive field were seen, even in receptive fields adjacent to, or partially within, a laser lesion site. Histological examination did not show any changes in the retinal organization adjacent to laser lesion even where the ganglion cells had center-only receptive fields.

11678 **(DOE/ER—0089) Environmental assessment for the satellite power system concept development and evaluation program: nonmicrowave health and ecological effects.** White, M.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1980. Contract W-7405-ENG-48. 89p. NTIS, PC A05/MF A01.

A Concept Development and Evaluation Program is being carried out for a proposed Satellite Power System (SPS). For purposes of this evaluation, a preliminary reference system has been developed. SPS, as described in the reference system, would collect solar energy on satellites in geosychronous orbit in space. The energy would be converted to microwaves and beamed to an earth-receiving antenna (rectenna). One task in the environmental part of the program is the assessment of the nonmicrowave effects on health and the environment. These effects would result from all phases of SPS development and operation. This report covers the current knowledge regarding these effects, and is based on the reference system. The assessment is summarized as to scope, methodology, impacts of terrestrial development, launch and recovery of spacecraft, space activities (including health effects of the space environment, ionizing radiation, electromagnetic exposure, spacecraft charging and environmental interactions, occupational hazards, etc.) and construction and operation of rectenna (ground receiving station).

11679 **(DOE/ER—0091) Comparative health and safety assessment of the satellite power system and other electrical generation alternatives.** (Argonne National Lab., IL (USA)). Dec 1980. Contract W-31-109-ENG-38. 147p. NTIS, PC A07/MF A01.

The work reported here is an analysis of existing data on the health and safety risks of a satellite power system and six electrical generation systems: a combined-cycle coal power system with a low-Btu gasifier and open-cycle gas turbine; a light water fission power system without fuel reprocessing; a liquid-metal, fast-breeder fission reactor; a centralized and decentralized, terrestrial, solar-photovoltaic power system; and a first-generation design for a fusion power system. The systems are compared on the basis of expected deaths and person-days lost per year associated with 1000 MW of average electricity generation. Risks are estimated and uncertainties indicated for all phases of the energy production cycle, including fuel and raw material extraction and processing, direct and indirect component manufacture, on-site construction, and system operation and maintenance. Also discussed is the potential significance of related major health and safety issues that remain largely unquantifiable. The appendices provide more detailed information on risks, uncertainties, additional research needed, and references for the identified impacts of each system.

11680 **(UR—3490-1832) Biologic response to microwave/RF energy.** Michaelson, S.M. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 1980. Contract AC02-76EV03490. 4p. (CONF-800501—2). NTIS, PC A02/MF A01.

From 15. annual IMPI symposium on microwave powers; Iowa City, IA, USA (6 May 1980).

A systematic and up-to-date review of observations and theoretical approaches to the biological effects and health implica-

tions of exposure to microwave/radiofrequency energies is presented. A primary objective is to review and place available information and concepts in proper perspective to understand and encourage the full potential for the beneficial uses of these energies while at the same time preventing adverse effects to individuals exposed to microwaves/RF.

57 HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 10318, 11693, 11804

11681 (ANL/ES—105) Health and environmental effects document for batteries: 1980. (Argonne National Lab., IL (USA)). Nov 1980. Contract W-31-109-ENG-38. 107p. NTIS, PC A06/MF A01.

An evaluation is presented of the ecological and health effects of the near-term electric storage batteries (lead/acid, nickel/zinc, and nickel/iron) as related to electric and hybrid vehicle applications. The storage battery technology is considered in its totality, and emissions are estimated for the complete cycle. For estimating quantities of various emissions, the market penetration is assumed to be 3 x 10^6 Pb/acid battery-powered vehicles and 8 x 10^6 each of the Ni/Zn and Ni/Fe battery-powered vehicles on the road by the year 2000. Ecological effects are assessed using the Estimated Permissible Concentration (EPC) approach. Pb, S, Cu, Ni, Cd, Zn, and Sb appear to be the most hazardous emission constituents and exceed EPC values for protection of ecology in one or more of the battery-related industries. More definitive, quantitative estimates of damage to the biota and to the ecosystem are not feasible because of paucity of relevant information. Health effects as a result of increased levels of lead, arsenic, and cadmium in the environment and risks of exposure to arsine, stibine, and antimony trioxide released during charging are assessed. Health effects among the occupationally exposed are also assessed using the toxicological models. Acute and chronic effects of exposure to stibine, arsine, and antimony trioxide are described.

11682 (BNL—28748) Exposure of rodents to particulate carcinogens. Drew, R.T.; Moorman, W.J. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract AC02-76CH00016. 20p. (CONF-7810255—2). NTIS, PC A02/MF A01.

From Inhalation chamber technology conference; Upton, NY, USA (16 Oct 1978).

An exposure chamber design for carcinogen particle testing facility is described that considers personnel safety as well as bioassay integrity. (PSB)

11683 (DOE/ER/10025—T1) Assessment of zero gravity effects on space worker health and safety. (National Aeronautics and Space Administration, Houston, TX (USA). Lyndon B. Johnson Space Center). Nov 1980. Contract AI01-79CH10025. 125p. NTIS, PC A06/MF A01.

One objective of the study is to assess the effects of all currently known deviations from normal of medical, physiological, and biochemical parameters which appear to be due to zero gravity (zero-g) environment and to acceleration and deceleration to be experienced, as outlined in the reference Solar Power Satellite (SPS) design, by space worker. Study results include identification of possible health or safety effects on space workers - either immediate or delayed - due to the zero gravity environment and acceleration and deceleration; estimation of the probability that an individual will be adversely affected; description of the possible consequence to work efficiently in persons adversely affected; and description of the possible/probable consequences to immediate and future health of individuals exposed to this environment. A research plan, which addresses the uncertainties in current knowledge regarding the health and safety hazards to exposed SPS space workers, is presented. Although most adverse affects experienced during space flight soon disappeared upon return to the Earth's environment, there remains a definite concern for the long-term effects to SPS space workers who might spend as much as half their time in space during a possible five-year career period. The proposed 90-day up/90 day down cycle, coupled with the fact that most of the effects of weightlessness may persist throughout the flight along with the realization that recovery may occupy much of the terrestrial stay, may keep the SPS workers in a deviant physical condition or state of flux for 60 to 100% of their five-year career. (JGB)

11684 (PB—80-184583) Effects of aerosols, oxides of nitrogen, and oxidants on human health. Final report. Kleinman, M.T.; Linn, W.S.; Hackney, J.D. (Professional Staff Association of the Rancho Los Amigos Hospital, Inc., Downey, CA (USA)). Dec 1979. 112p. NTIS, PC A06/MF A01.

Rancho Los Amigos Hospital carried out four separate tasks under this project, each task independent of the others. In Task I, Exposures to Ammonium Nitrate, volunteers in normal health and volunteers with asthma were exposed to polydisperse ammonium nitrate aerosol under conditions simulating worst-case ambient exposures. In Task II, Exposures to Mixed Ozone, Sulfur Dioxide, and Sulfuric Acid, normal volunteers exposed to 0.37 ppm ozone plus 0.37 ppm sulfur dioxide plus 100 micrograms/cu m polydisperse sulfuric acid aerosol (which was partly neutralized by ammonia during exposure) under simulated ambient conditions showed small statistically significant decrements in forced expiratory function. Task III, Exposures to Ambient Air, was intended to determine whether responses to ambient photochemical smog exposure in a mobile laboratory accurately represented responses which would occur outdoors. Task IV, Ozone Exposure and Arterial Blood Oxygenation, sampled hemoglobin saturation repeatedly with a Hewlett-Packard ear oximeter during exposures of volunteers to ozone under simulated ambient conditions.

11685 (PB—80-812191) Hazardous materials waste disposal. 1977-June, 1980 (citations from the NTIS data base). Report for 1977-Jun 80. Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Jun 1980. 228p. NTIS PC N01/MF N01.

Topics relate to disposal of pesticides, explosives, chemical warfare agents, dangerous industrial chemicals, and other types of hazardous materials. The citations include research on management planning, spills, toxicity, water pollution abatement, and National Disposal Sites. Pollution studies related to disposal in landfills and by incineration are also covered as is deep mine disposal. Radioactive wastes are excluded. (This updated bibliography contains 217 abstracts, 38 of which are new entries to the previous edition.)

11686 Medical basis for radiation accident preparedness. Huebner, K.F.; Fry, S.A. (eds.). New York, NY; Elsevier North Holland, Inc. (1980). 580p. (CONF-791085—).

From Radiation accident preparedness conference; Oak Ridge, TN, USA (19 Oct 1979).

The International Conference on The Medical Basis for Radiation Accident Preparedness was organized by the staff of the Radiation Emergency Assistance Center/Training Site (REAC/TS) of the Medical and Health Sciences Division of Oak Ridge Associated Universities (ORAU). The philosophical importance of relating, through investigation and education, the intellectual resources of higher education to the important social problems associated with energy, health, and the environment was the foundation of the meeting. The symposium, held under the auspices of the US Department of Energy, was the ninth since 1960 of a series of international conferences addressing the various aspects of radiation accidents. The approach of this most recent conference differed somewhat from that of those preceding it, in that it sought an international review of the gamut of the medical aspects of radiation injury, not only for the experts in the field, but also for other physicians and scientists who, in view of current events, have had the need to know thrust upon them. Individual entries were made for the separate papers.

11687 (BNL—28749) Development of the standard inhalation chamber. Drew, R.T. (Brookhaven National Lab., Upton, NY (USA)). [nd]. Contract AC02-76CH00016. 13p. (CONF-8010151—1). NTIS, PC A02/MF A01.

From Inhalation chamber technology conference; Upton, NY, USA (16 Oct 1980).

Various designs of inhalation chambers developed since the Manhattan Project are discussed. Essential features of current inhalation chambers are illustrated. It is stated that technology is available to control almost any variable in inhalation studies, although

cost factors must be taken into consideration when experiments are designed. (JGB)

58 GEOSCIENCES

REFER ALSO TO CITATION(S) 10372

11688 **(RHO-BWI-SA—69) Discriminant analysis as a method of flow identification and correlation in layered basalt provinces.** Reidel, S.P.; Long, P.E. (Rockwell International Corp., Richland, WA (USA). Energy Systems Group). Nov 1980. Contract AC06-77RL01030. 16p. NTIS, PC A02/MF A01.

Discriminant analysis was applied to over 50 flows of the Columbia River Basalt Group which range from widely differing compositions (Saddle Mountains Basalt) to only slight chemical differences (Grande Ronde Basalt). Well-defined, correlated stratigraphic sections were tested for the probability of correctly identifying individual flows or groups of flows. Probability of properly identifying samples from flows of the Saddle Mountains Basalt approaches 1.0. The Grande Ronde Basalt constitutes approximately 85% of the Columbia River basalt and consists of >35 flows, yet it has previously been divided into only three chemical groups. Using 21 variables for each sample and 28 groups, ~ 67% of the samples were correctly identified with probabilities ranging from 0.3 to 0.9. Elements that were particularly important in discriminating Grande Ronde Basalt flows were MgO (3.0 to 6.0 wt %), TiO_2 (1.6 to 2.6 wt %), Zr (160 to 250 ppM), Ba (300 to 1050 ppM), and P_2O_5 (0.2 to 0.5 wt %).

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 10335, 10394

11689 **(CONF-7905180—) Carbon dioxide effects research and assessment program.** Jacoby, G. (ed.). (Columbia Univ., Palisades, NY (USA). Lamont-Doherty Geological Observatory). Dec 1980. Contract AC02-79ER10037. 156p. NTIS, PC A08/MF A01.

From International meeting on stable isotopes in tree-ring research; New Paltz, NY, USA (22 May 1979).

Information about the past and present concentrations of CO_2 in the atmosphere and variations in climate can be obtained from measurements of stable isotopes in tree rings; specifically carbon-13, oxygen-18 and deuterium. The analysis of these stable isotopes in tree rings is a relatively new and rapidly developing field. This proceedings volume contains most of the papers presented at the meeting. The first paper gives an overview of the status of carbon-13 research. Papers relating to carbon-13 are in section I and grouped separately from the contributions on carbon-14. Although the meeting was primarily concerned with stable isotopes, all carbon isotopic analysis may be helpful in understanding the carbon-13 record in tree rings. The papers on hydrogen and oxygen isotope studies are in sections II and III respectively. The remaining sections contain papers that consider more than one isotope at a time, general topics related to isotopes, atmospheric changes and tree growth, and methods of isotopic analysis.

11690 **(DP—1562) Review of potential host rocks for radioactive waste disposal in the Piedmont province of North Carolina.** Butler, J.R. (North Carolina Univ., Chapel Hill (USA). Dept. of Geology). Oct 1980. Contract AC09-76SR00001. 50p. NTIS, PC A03/MF A01.

This report reviews the geology of the Piedmont province in North Carolina, emphasizing those features most pertinent to selection of potential host rocks for radioactive waste disposal. Discussion of criteria for selection indicates that the outcrop area of the rock body, probable homogeneity, low incidence of fractures, and low permeability are among the prime considerations. Application of the criteria leads to the selection of three large granite batholiths (Castalia, Churchland, and Rolesville) as potential field study areas. The report has an extensive bibliography.

11691 **(DP—1564) Review of potential host rocks for radioactive waste disposal in the Piedmont Province of Georgia.** Wenner, D.B.; Gillon, K.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Oct 1980. Contract AC09-76SR00001. 51p. NTIS, PC A04/MF A01.

A literature study was conducted on the Piedmont province of Georgia to designate areas that may be favorable for field exploration for consideration of a repository for storage of radioactive waste. The criteria utilized in such a designation was based upon consideration of the rock unit having favorable geological, geotechnical, and geohydrological features. The most important are that the rock unit have: (1) satisfactory unit dimensions (> 100 km^2 outcrop area and at least 1500 meters (approx. 5000 feet) depth of a continuous rock type); and (2) acceptable geohydrological conditions. Among all rock types, it is concluded that the granites of the large post-metamorphic plutons and large, homogeneous orthogneissic units offer the most favorable geologic settings for exploration for siting a radioactive waste repository. Virtually all other rock types, including most metavolcanic and metasedimentary lithologies have unacceptable unit dimensions, generally unfavorable geohydrologic settings, and deleterious mechanical and physical geotechnical properties. After consideration of all major lithologies that comprise the Georgia Piedmont, the following units were deemed favorable: (1) the Elberton Pluton; (2) the Siloam Pluton; (3) the Sparta Pluton; (4) two unnamed plutons adjacent to the Snelson body of S.W. Georgia; (5) the Lithonia Gneiss; (6) basement orthogneisses and charnockites of the Pine Mountain Belt.

11692 **(USGS-OFR—81-119) Uranium-thorium dating of quaternary carbonate accumulations in the Nevada Test Site region, southern Nevada.** Szabo, B.J.; Carr, W.J.; Gottschall, W.C. (Geological Survey, Denver, CO (USA); Denver Univ., CO (USA)). 1981. Contract AI08-78ET44802. 38p. NTIS, PC A03/MF A01.

A useful way to approach the problem of tectonic activity in an arid region is through study of the history of movement of faults and fractures and of the young alluvial material they displace. Easily datable materials are scarce in these deposits, but carbonates such as caliche, calcrete, travertine, calcite vein, and tufa are common. Several types of these carbonates from the Nevada Test Site area in the southern Great Basin have been collected and dated by the uranium-series method. A variety of geologic settings are represented. The carbonate samples were subjected to a complex treatment process, and the resulting preparations were counted on an alpha spectrometer. Some of the samples from obviously closed systems yielded reasonable ages; others gave only a minimum age for a material or event. Many of the ages obtained agree well with estimates of age determined from dated volcanic units, fault-scarp morphology, and displaced alluvial units. Among the significant ages obtained were three dates of greater than 400,000 years on calcite-filling fractures above and below the water table in an exploratory drill hole for a possible candidate nuclear waste repository site at Yucca Mountain. Another date on calcrete from immediately below the youngest basalt in the region gave an age of 345,000 years, which agrees extremely well with the K-Ar age determined for the basalt of about 300,000 years. Undisturbed travertine that fills faults in several areas gave ages from about 75,000 years to greater than 700,000 years. Soil caliche and calcretes slightly displaced or broken by repeated movement on faults gave minimum ages in the range from more than 5000 to more than about 25,000 years.

5802 Geophysics

11693 **(DOE/CH/93003—4) Earthquake research for the safer siting of critical facilities.** Cluff, J.L. (ed.). (National Academy of Sciences, Washington, DC (USA)). 1980. Contract AT02-76CH93003. 59p. NTIS, PC A04/MF A01.

The task of providing the necessities for living, such as adequate electrical power, water, and fuel, is becoming more complicated with time. Some of the facilities that provide these necessities would present potential hazards to the population if serious damage were to occur to them during earthquakes. Other facilities must remain operable immediately after an earthquake to provide life-support services to people who have been affected. The purpose of

this report is to recommend research that will improve the information available to those who must decide where to site these critical facilities, and thereby mitigate the effects of the earthquake hazard. The term critical facility is used in this report to describe facilities that could seriously affect the public well-being through loss of life, large financial loss, or degradation of the environment if they were to fail. The term critical facility also is used to refer to facilities that, although they pose a limited hazard to the public, are considered critical because they must continue to function in the event of a disaster so that they can provide vital services.

11694 **(DOE/CH/93003—5) US earthquake observatories: recommendations for a new national network.** (National Academy of Sciences, Washington, DC (USA)). 1980. Contract AT02-76CH93003. 136p. NTIS, PC A07/MF A01.

This report is the first attempt by the seismological community to rationalize and optimize the distribution of earthquake observatories across the United States. The main aim is to increase significantly our knowledge of earthquakes and the earth's dynamics by providing access to scientifically more valuable data. Other objectives are to provide a more efficient and cost-effective system of recording and distributing earthquake data and to make as uniform as possible the recording of earthquakes in all states. The central recommendation of the Panel is that the guiding concept be established of a rationalized and integrated seismograph system consisting of regional seismograph networks run for crucial regional research and monitoring purposes in tandem with a carefully designed, but sparser, nationwide network of technologically advanced observatories. Such a national system must be thought of not only in terms of instrumentation but equally in terms of data storage, computer processing, and record availability.

11695 **(DP—1579) Numerical simulations of earthquake effects on tunnels for generic nuclear waste repositories.** Wahi, K.K.; Trent, B.C.; Maxwell, D.E.; Pyke, R.M.; Young, C.; Ross-Brown, D.M. (Science Applications, Inc., Fort Collins, CO (USA)). Dec 1980. Contract AC09-76SR00001. 132p. NTIS, PC A07/MF A01.

The objectives of this generic study were to use numerical modeling techniques to determine under what conditions seismic waves generated by an earthquake might cause instability to an underground opening, or cause fracturing and joint movement that would lead to an increase in the permeability of the rock mass. Three different rock types (salt, granite, and shale) were considered as host media for the repository located at a depth of 600 meters. Special material models were developed to account for the nonlinear material behavior of each rock type. The sensitivity analysis included variations in the in situ stress ratio, joint geometry, pore pressures, and the presence or absence of a fault. Three different sets of earthquake motions were used to excite the rock mass. The calculations were performed using the STEALTH codes in a three-stage process. It was concluded that the methodology is suitable for studying the effects of earthquakes on underground openings. In general, the study showed that moderate earthquakes (up to 0.41 g) did not cause instability of the tunnel or major fracturing of the rock mass. A rock-burst tremor with accelerations up to 0.95 g, however, was found to be amplified around the tunnel, and fracturing occurred as a result of the seismic loading in salt and granite. In shale, even moderate seismic loading resulted in tunnel collapse. Other questions appraised in the study include the stability of granite tunnels under various combinations of joint geometry and in situ stress states, and the overall stability of tunnels in shale subject to the thermomechanical loading conditions anticipated in an underground waste repository.

11696 **(SAND—80-2071) Deconvolution using the complex cepstrum.** Riley, H.B. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1980. Contract AC04-76DP00789. 40p. NTIS, PC A03/MF A01.

The theory, description, and implementation of a generalized linear filtering system for the nonlinear filtering of convolved signals are presented. A detailed look at the problems and requirements associated with the deconvolution of signal components is undertaken. Related properties are also developed. A synthetic example is shown and is followed by an application using real seismic data. 29 figures.

11697 **(SAND—80-2718C) Long-term measurements of ground motions offshore.** Reece, E.W.; Ryerson, D.E. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 4p. (CONF-810412—1). NTIS, PC A02/MF A01.

From International conference on recent advances in geotechnical earthquake and soil dynamics; St Louis, MO, USA (26 Apr 1981).

Long-term measurements of earthquake ground motions offshore, using the Sandia National Laboratories' SEMS device which records only the strongest motions and transmits them upon command to a boat at the surface, have shown that offshore ground motions may in certain cases be substantially different from empirically predicted ground motions based on onshore data. In particular, the attenuation effects of soft and/or gassy soils, the wedging of offshore deposits as a function of direction to and distance from the source, and sharp velocity-depth profiles, are shown to be possible factors contributing to such differences. For the well constrained recording to date, the offshore ground motions are only 13 to 23 percent of those which would be calculated using empirical predictions based on onshore data. To address this situation, Sandia has installed a net of three long-lived (SEMS), two of them in the vicinity of instrumented platforms, in the Sandia Barbara Channel. The results are intended to evaluate the earthquake hazards of offshore energy developments and to provide firm data on the design parameters required for the harvesting of offshore energy resources.

11698 **(UCRL—85330) Recursive least squares with linear constraints.** Harris, D.B. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 8 Jan 1981. Contract W-7405-ENG-48. 6p. (CONF-810413—1). NTIS, PC A02/MF A01.

From ICASSP '81; Atlanta, GA, USA (1 Apr 1981).

The use of linear constraints on the coefficients of adaptive transversal filters is proposed for the extraction of polarized waveforms from two-channel signals. The method is demonstrated using real seismic data.

11699 **Bidirectional ground coupling means for inclined seismic source.** Airhart, T.P. (to Atlantic Richfield Co). US Patent 4,222,454. 16 Sep 1980. Filed date 2 Jan 1979. vp.

Apparatus for generating combined compressional and shear wave signals in the earth which employs a seismic source, such as a cylindrical gas exploder, having a free-moving wedge shaped base which tapers symmetrically downwardly to a thin blade. When the exploder is fired at an angle inclined to the vertical, a force is generated along its longitudinal axis which drives the base downwardly in the same direction so as to propagate seismic signals having a compressional component and a shear component. The blade is disposed transversely to the direction of the horizontal component of this applied force. The penetration achieved by the thin blade portion of the base insures sufficient earth coupling to generate high energy shear seismic signals and minimizes horizontal translation of the exploder under a wide range of soil conditions. The axial symmetry of the base permits the exploder to be rotated in place about a horizontal axis and fired a second time to generate seismic waves of equal magnitude and of opposite phase at the same point on the earth's surface.

11700 **Vibration generators.** Lerwill, W.E. (to Seismograph Service Corp). US Patent 4,222,455. 16 Sep 1980. Filed date 16 Jan 1978. vp.

Apparatus for generating vibrations in a medium, such as the ground, comprises a first member which contacts the medium, means , preferably electromagnetic, which includes two relatively movable members for generating vibrations in the apparatus and means operatively connecting the said two members to said first member such that the relatively amplitudes of the movements of said three members can be adjusted to match the impedances of the apparatus and the medium.

5803 Mineralogy, Petrology, And Rock Mechanics

11701 **(DP—1569) Review of potential host rocks for radioactive wasste disposal in the southeast United States: Triassic basin subregion.** (Dames and Moore, Atlanta, GA (USA)). Oct 1980. Contract AC09-76SR00001. 278p. NTIS, PC A13/MF A01.

Extensive bibliography.

Based on an evaluation of existing information, areas were identified within the Triassic basins of the southeastern United States with geologic properties considered favorable for containment of radioactive waste. The study region included both exposed and buried Triassic basins from Maryland to Georgia. These basins are long, narrow northeast-trending troughs filled with continental deposits derived from Paleozoic and Precambrian metamorphic and igneous rocks bordering the basins. The rocks are predominantly red in color and consist mainly of fanglomerates, conglomerates, arkosic sandstones, siltstones, claystones, shales, and argillites. The investigation identified 14 exposed and 5 buried basins within the study region. Candidate areas for further investigation were identified which meet the broad general criteria for tectonic stability, slow ground water movement, and long flow paths to the biosphere. These include: the Danville Triassic Basin in Virginia; the Dan River, Durham, and Wadesboro Triassic Basins in North Carolina; and the buried Florence and Dunbarton Triassic Basins in South Carolina. Other rock types in the southeast may prove more or less suitable as host rocks for a repository, but the available data suggest that the argillaceous Triassic rocks offer sufficient promise to be considered for additional study.

11702 **(PNL—2847) Hanford basalt flow mineralogy.** Ames, L.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1980. Contract AC06-76RL01830. 469p. NTIS, PC A20/MF A01.

Mineralogy of the core samples from five core wells was examined in some detail. The primary mineralogy study included an optical examination of polished mounts, photomicrographs, chemical analyses of feldspars, pyroxenes, metallic oxides and microcrystalline groundmasses and determination from the chemical analyses of the varieties of feldspars, pyroxenes and metallic oxides. From the primary mineralogy data, a firm understanding of the average Hanford basalt flow primary mineralogy emerged. The average primary feldspar was a laboradorite, the average pyroxene was an augite and the average metallic oxide was a solid solution of ilmenite and magnetite. Secondary mineralization consisted of vug filling and joint coating, chiefly with a nontronite-beidellite clay, several zeolites, quartz, calcite, and opal. Specific flow units also were examined to determine the possibility of using the mineralogy to trace flows between core wells. These included units of the Pomona, the Umatilla and a high chromium flow just below the Huntzinger. In the Umatilla, or high barium flow, the compositional variation of the feldspars was unique in range. The pyroxenes in the Pomona were relatively highly zoned and accumulated chromium. The high chromium flow contained chromium spinels that graded in chromium content into simple magnetites very low in chromium content. A study of the statistical relationships of flow unit chemical constituents showed that flow unit constituents could be roughly correlated between wells. The probable cause of the correlation was ongoing physical-chemical changes in the source magma.

11703 **(SAND—80-2655C) Estimation of in-situ clay strengths using marine sediment penetrators.** McNeill, R.L. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 8p. (CONF-810412—3). NTIS, PC A02/MF A01.

From International conference on recent advances in geotechnical earthquake and soil dynamics; St Louis, MO, USA (26 Apr 1981).

A method has been developed to calculate soil shear strengths from the measured decelerations of a free-fall penetrator. The method is easy to apply, and appears to yield accurate estimates of in-situ soil strength over a wide variety of soil conditions, and for many different sizes and weights of penetrators. For gassy and/or sensitive soils, the method may yield strength values more accurate than those determined by conventional boring, sampling, and laboratory testing.

11704 **(SAND—80-2719C) In-situ measurements of pore pressures.** McNeill, R.L.; Reece, E.W. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 5p. (CONF-810412—2). NTIS, PC A02/MF A01.

From International conference on recent advances in geotechnical earthquake and soil dynamics; St Louis, MO, USA (26 Apr 1981).

As engineering moves into deeper waters, measurements of soil properties in the laboratory may be highly suspect if the soils are gassy. Strength and pore-pressure data are presented and discussed. A suggestion is made for development of pore-pressure gauges to detect the presence of clathrates.

11705 **(UCRL—53073) Constitutive models for compressive loading of geologic materials.** Thigpen, L.; Chin, R.C.Y. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 20 Nov 1980. Contract W-7405-ENG-48. 22p. NTIS, PC A02/MF A01.

This paper addresses some aspects of the theory of plastic straining which unify the constitutive equations for geologic materials under compressive loading. Existing models are generalized with particular emphasis on ascertaining the minimum number of phenomenological coefficients required to adequately represent these models. Results show that both single- and multiple-mode plasticity models may be generalized to the same form. Five phenomenological coefficients are adequate to describe the response of strain-hardening materials to compressive loading.

5804 Geochemistry

11706 **Amorphous silica solubilities. I. Behavior in aqueous sodium nitrate solutions: 25 to 300°C, 0 to 6 molal.** Marshall, W.L. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Geochimica et Cosmochimica Acta ;* **44**: No. 7, 907-913(Jul 1980).

The solubility of amorphous silica was obtained in aqueous sodium nitrate solutions up to six molal and at temperatures from 25 to 300°C. It was expected that solubilities in aqueous sodium chloride solutions would be similar. At 25°C, the solubility of amorphous silica is lowered from that in water to 0.00086 m in 6.12 m sodium nitrate, or a decrease of 60%. At 300°C, the corresponding decrease is only 27% from a solubility of 0.0269 m in H_2O. From the change in solubility with temperature at a given constant molality of sodium nitrate, the molal heat of solution over the range, 100 to 300°C, increases from $+2.93$ kcal mol^{-1} in water to $+3.64$ kcal mol^{-1} in 6 m sodium nitrate. The value approaches a constant of $+3.8$ kcal mol^{-1} as sodium nitrate approaches saturation at 10.8 molal. 7 figures, 2 tables.

11707 **Amorphous silica solubilities. II. Effect of aqueous salt solutions at 25°C.** Marshall, W.L.; Warakomski, J.M. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Geochimica et Cosmochimica Acta ;* **44**: No. 7, 915-924(Jul 1980).

The solubility of amorphous silica was measured at 25°C in ten separate sets of aqueous salt solutions - potassium chloride, potassium nitrate, sodium chloride, lithium chloride, lithium nitrate, magnesium chloride, calcium chloride, magnesium sulfate, sodium bicarbonate and sodium sulfate. The concentrations of the salts were varied from zero to saturation with both salt and amorphous silica. With increasing concentration of salt, the solubility of amorphous silica always decreased as expected from an average value of 0.00218 m in water. Nevertheless, the extent of decrease differed greatly from a 6% decrease in a solution saturated with $NaHCO_3$ to a 95.7% decrease in a solution saturated with $CaCl_2$. A striking correlation was observed: in the 1 to 1 and 2 to 1 electrolyte salt solutions at a given molality the effect on the solubility of silica depended upon the cation in the order Mg^{2+}, $Ca^{2+} > Li^+ > Na^+ > K^+$. 9 figures, 1 table.

11708 **Amorphous silica solubilities. III. Activity coefficient relations and predictions of solubility behavior in salt solutions, 0 to 350°C.** Marshall, W.L. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Geochimica et Cosmochimica Acta ;* **44**: No. 7, 925-931(Jul 1980).

Activity coefficients of amorphous silica in added salt solutions, obtained from solubility measurements, were calculated on the basis of concentration (molarity) and composition (molality). The logarithm of the activity coefficients based on concentration when plotted against molarity of added salt, as previous observations would dictate, yielded straight line relations even to 6 M. The use of composition units produced instead curves at the highest molalities and caused divergences in behavior from the single straight lines for 1-1 salts of a common cation. Introduction of the activity of water also caused divergences in behavior. Thus, it might appear that amorphous silica is fully hydrated at 25°C as a solid in equilibrium with solution. Lack of densities of aqueous sodium nitrate necessitated using units of molality in interpretations at high temperature. Nevertheless, approximately straight line behavior of log activity coefficient vs m was still observed to reasonably high molalities, and allowed a simple equation to describe activity coefficient behavior as a function of both molality of sodium nitrate and temperature. The simplicity of the relation, with some assumptions, might be used to predict solubility of amorphous silica at high temperatures in other added aqueous salt solutions. 6 figures, 3 tables.

5805 Oceanography

11709 **(DOE/EV/00901—5) Coordination: southeast continental shelf studies. Progress report.** Menzel, D.W. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 1 Feb 1981. Contract AS09-76EV00901. 31p. NTIS, PC A03/MF A01.

The objectives are to identify important physical, chemical and biological processes which affect the transfer of materials on the southeast continental shelf, determine important parameters which govern observed temporal and spatial varibility on the continental shelf, determine the extent and modes of coupling between events at the shelf break and nearshore, and determine physical, chemical and biological exchange rates on the inner shelf. Progress in meeting these research objectives is presented. (ACR)

11710 **(DOE/EV/00901—T2) Coordination: Southeast Continental Shelf studies. Progress report.** Menzel, D.W. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 1 Feb 1981. Contract AS09-76EV00901. 31p. NTIS, PC A03/MF A01.

An overview of the Oceanograhic Program of Skidaway Institute of Oceanograhy is presented. Included are the current five year plan for studies of the Southeast Continental Shelf, a summary of research accomplishments, proposed research for 1981-1982, current status of the Savannah Navigational Light Tower, and a list of publications. (ACR)

64 PHYSICS RESEARCH

6401 Astrophysics And Cosmology

11711 **(AD-A—086010) Dynamical phenomena in sunspots. Final report 1 Oct 76-30 Sep 79.** Thomas, J.H.; Clark, A. Jr.; Scheuer, M.A. (Rochester Univ., NY (USA). Dept. of Mechanical and Aerospace Sciences). 15 Feb 1980. 85p. NTIS, PC A05/MF A01.

The reflection of upward and downward propagating Alfven waves in sunspots is studied, in order to assess the possibility of cooling by Alfven waves. Wave reflection is studied by means of a three-layer model of the umbral atmosphere. The results show very strong downward reflection of Alfven waves in the photosphere and low temperature, but only weak upward reflection in the convection zone. Further study of more realistic magneto-atmospheric waves (including the effects of compression and buoyancy) shows strong upward reflection in the convection zone as well as strong downward reflection in the photosphere and low chromosphere. These results tend to rule out significant sunspot cooling by waves. A study of a simple thermal model of a sunspot, based on the concept of partial inhibition of convection, shows that the inhibition mechanism can yield acceptable distributions of surface temperature. The results of this model also show that: (1) the edge of the umbra is sharp, even for deep spots; (ii) deep spots produce weak bright rings, but shallow spots produce intense bright rings in conflict with observations; and (iii) only a shallow surface layer of the sunspot is cool, the rest being warmer than the surroundings. Umbral oscillations in sunspots are studied and identified a resonant response of the umbral atmosphere to forcing by oscillatory convection in the subphotosphere. The full linearized equations for magneto-atmospheric waves are solved numerically for a detailed model of the umbral atmosphere. It is suggested that the Sun's radius and surface temperature vary with the solar cycle due to the variation of total magnetic buoyancy in the convection zone over the cycle of the solar dynamo.

11712 **(AD-A—086817) Research on prediction techniques for the time dependence of solar particle events and geomagnetic activity from results of synoptic analysis of solar and interplanetary particle, plasma and field observations. Final report 1 Jul 75-30 Sep 79.** Roelof, E.C.; Gold, R.E. (Johns Hopkins Univ., Silver Spring, MD (USA). Applied Physics Lab.). Mar 1980. 21p. NTIS, PC A02/MF A01.

A total of eight scientific techniques have been investigated as an aid for prediction of solar energetic particle events and geomagnetic storms; (1) Synoptic analysis of interplanetary data; (2) H sub ALPHA synoptic charts of low coronal magnetic structure; (3) Solar wind mapping of high coronal emission longitude of solar wind plasma and large-scale interplanetary magnetic field lines; (4) Analysis of energetic particle propagation; (5) Intercomparison of data from separated spacecraft; (6) Charts of solar optical, radio and x-ray activity; (7) Synthesis of solar and interplanetary data; and (8) Integration of interplanetary radio scintillation observations. The progress made in these techniques and their applications is reviewed and evaluated. Based on these results, new recommendations are offered for prediction and operational forecasting.

11713 **(AD-A—087109) Sources and sinks of energetic electrons and protons in saturn's magnetosphere. Progress report.** Van Allen, J.A.; Randall, B.A.; Thomsen, M.F. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Apr 1980. 74p. NTIS, PC A04/MF A01.

This paper reports the results of continuing analysis and interpretation of energetic particle observations obtained by the University of Iowa instrument on Pioneer 11 during traversal of Saturn's magnetosphere in August-September 1979. On the basis of the radial dependence of the phase space density of very energetic protons (E(p) > 80 MeV) and estimates of the necessary source strength, it is reasonably certain that cosmic ray neutron albedo from the planet's atmosphere and Rings A and B is the source of such particles. At radial distance r = 2.7 R(s) and for E(p) > 80 MeV, the ratio of source strength s to radial diffusion coefficient D is approx. 2 x 10 to the 24th power cm(exp 5).

11714 **(AD-A—087110) Magnetospheric and interplanetary electrostatics: a simple but explicit model. Interim report.** Schulz, M. (Aerospace Corp., El Segundo, CA (USA). Space Sciences Lab.). 1 Jul 1980. 10p. NTIS, PC A02/MF A01.

This is a generalization of Dungey's 1961 model for the prototype of an 'open' magnetosphere. The magnetic-field lines are traced by superimposing a uniform B field parallel to the geomagnetic dipole axis. There results a quasi-cylindrical separatrix (the 'magnetopause') between field lines that intersect the earth and those that do not. However, the magnetic field outside the magnetosphere can be multiplied by an arbitrary factor (positive or negative) without altering the field-line geometry. Any discontinuity in B at the 'magnetopause' is supported by azimuthal currents there. The electrostatic problem is asymptotically analogous to that of a dielectric cylinder in an asymptotically uniform electric field (which owes its origin to the solar wind in this case). It is easy to map from the asymptotic solution inward and equatorward, since the magnetic field lines are treated as electric equipotentials. The tangential component of the electric field is continuous at the magnetopause but varies between limits that correspond to the 'open' and 'closed' models of the magnetosphere, as defined by the access of interplanetary plasma.

11715 **(AD-A—087118) Corotation of Saturn's magnetosphere: evidence from energetic proton anisotropies. Revision. Progress report.** Thomsen, M.F.; Northrop, T.G.; Schardt, A.W.; Van Allen, J.A. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Jun 1980. 35p. NTIS, PC A03/MF A01.

The theory and technique of Northrop and Thomsen 1980 are applied to observations of energy spectra and directional anisotropies of 0.61 - 3.41 MeV protons in Saturn's magnetosphere. The observations were made by the Goddard Space Flight Center/University of New Hampshire and University of Iowa instruments aboard Pioneer 11 during the Pioneer encounter with Saturn in August/September 1979. Fourier fits to 15-minute intervals of data are combined with spectral indices to yield information about the E x B convection velocity and temporal changes in the particle population. There is a fundamental inability to distinguish unambiguously between the two, but if one can be assumed, the other then follows from these calculations. It is found that although these data do not by themselves allow an unambiguous determination of the extent of corotation in Saturn's outer magnetosphere, they are consistent with exact corotation at the nominal rotation period in the presence of significant but not unreasonable temporal variations in the energetic proton population.

11716 **(LA-UR—80-3474) Chemical kinetics in the coma.** Huebner, W.F. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 25p. (CONF-8010155—1). NTIS, PC A02/MF A01.

From Colloquia on chemical evolution, colloquium V, comets and the origin of life; College Park, MD, USA (29 Oct 1980).

Physical and chemical conditions in the coma of a bright new comet are related to the composition of the nucleus. Chemical and photolytic processes are described and related to distance in the coma above the nucleus and to heliocentric distance of the comet. Comparison of the model with coma observations leads to some restrictions about the nucleus composition. It is expected that these restrictions become more stringent as coma models are developed further and as observations become more detailed.

11717 **X-ray characteristics of the Lupus Loop and SN 1006 supernova remnants.** Toor, A. (Univ. of California, Livermore). Contract W-7405-ENG-48. *Astronomy and Astrophysics ;* **85**: 184-190(1980).

The spatial extent of the Lupus Loop and spectra for the Lupus Loop and SN1006 supernova remnants have been determined with a rocket-borne payload. The Lupus Loop is an extended source of soft X-rays (~ 300′ diam) that shows a correlation between its brightest x-ray and radio-emission regions. Its spectrum is characterized by a temperature of 350 eV. Thus, the Lupus Loop appears similar to Vela X and Cygnus Loop, although much weaker. Emission from SN1006 is spatially unresolved and exhibits a harder spectrum than that of the Lupus Loop. All spectral data (0.2 to 10 keV) from our observation and previous observations are satisfactorily fit with a power law (index = 2.15). This spectral dependence suggests the possibility that a rotating neutron star is the underlying source of the radiated energy although such an interpretation appears inconsistent with the remnant's morphology.

6402 Atmospheric Physics

11718 **(AD-A—086129) Elf propagation in the presence of nonstratified ionospheric disturbances. Final report May 79-Feb 80.** Field, E.C. Jr.; Gayer, S.J.; D'Ambrosio, B.P. (Pacific Sierra Research Corp., Santa Monica, CA (USA)). Jun 1980. 50p. NTIS, PC A03/MF A01.

This report analyzes the propagation of the TEM-ELF waveguide mode when the ionosphere is not stratified. It treats strong localized ionospheric disturbances by recasting the lateral wave equation as a two-dimensional integral equation, and applies a specially developed algorithm to obtain numerical solutions. The quasi-full-wave results show that a localized ionospheric disturbance behaves like a converging cylindrical lens filling a narrow aperture. Lateral diffraction and focusing, ignored in treatments that do not fully account for transverse ionospheric structure, cause the ELF signal to exhibit a pattern of maxima and minima on the line normal to the path passing through the center of the disturbance. As expected, the focusing/diffraction effects diminish when the transverse dimension of the disturbance exceeds the width of the first Fresnel zone--typically, several megameters. The analysis models widespread inhomogeneities, such as within the polar cap or at the day/night terminator, as semiinfinite regions separated by diffuse boundaries; it then derives full-wave analytic expressions for the reflection of the TEM mode. Mode reflection is found to significantly affect an ELF signal in two actual situations: first, when receivers are on great circle paths that are nearly tangential to the disturbed polar cap--in which case shadow zones and interference patterns can occur; and second, when signals are incident on the day/night terminator (from the day side) at angles exceeding about 75 deg--in which case the signals are affected by a phenomenon analogous to total internal reflection. Reflection is found to be unimportant if the boundary thickness exceeds about one-sixth of a wavelength.

11719 **(AD-A—086221) Assessment of magnetospheric processes of importance. Final report 1 Apr 78-15 Mar 79.** Cladis, J.B.; Davidson, G.T.; Francis, W.E.; Newkirk, L.L.; Walt, M. (Lockheed Missiles and Space Co., Palo Alto, CA (USA)). 15 Mar 1979. 84p. NTIS, PC A05/MF A01.

Conditions in the unstable field-aligned current sheet above the auroral oval have been obtained from analyses of the electron and ion measurements on the S3-3 satellite. The measurements were obtained while the satellite was in and near the nominal region of the current sheet, remaining within a few degrees in invariant latitude, over a magnetic local-time interval of about 6 hours. Potential differences along the magnetic field, above and below the satellite, were inferred from the energy and pitch-angle distributions of the electrons. These potential differences, which exceeded 10 kV at times, were generally higher during the local evening than during the local afternoon, and were quite variable along the satellite trajectory, indicating latitudinal fluctuations of the current sheet with periods of 2-7 minutes. Upward flowing H+ and O+ ions were observed whenever the potential differences exceeded about .5 kV, which corresponds to the lowest energy threshold of the detectors. However, the pitch-angle distributions of the ions imply that the ions were accelerated not only along the magnetic field by the potential difference, but also perpendicularly to the field. The transverse acceleration of the ions most probably occurred through interactions with electrostatic ion cyclotron (EIC) waves, which are an expected product of the current-driven instability, and which have been observed in the current-sheet region.

11720 **(AD-A—086222) High-latitude scintillation morphology, Alaskan sector. Topical report 1 May 76-1 Apr 78.** Matthews, S.J.; Rino, C.L. (SRI International, Menlo Park, CA (USA)). 1 Oct 1979. 53p. NTIS, PC A04/MF A01.

This report describes the auroral-zone scintillation morphology as deduced from two years of observations made at Poker Flat, Alaska, using the DNA Wideband satellite. The data confirm that magnetic activity is the principal factor in determining the level of both nighttime and daytime auroral-zone scintillation. No systematic seasonal variation in activity was found, although the second year (1977-1978) showed a significant increase in overall activity when compared with the first year (1976-1977). This increase is correlated with the general increase in solar activity, with the approach of the expected solar cycle maximum around 1980. The average latitudinal distribution of the nighttime scintillation activity shows a pronounced enhancement at the point where the propagation path intercepts the local L shell. The scintillation enhancement is more prominent in the phase scintillation data; this has been attributed primarily to a geometrical effect, although there is evidence of a columnar F-region source that has contributed as well.

11721 **(AD-A—086420) Plasma field studies during magnetic disturbances. Final report Aug 79-Jun 80.** Olson, W.P.; Pfitzer, K.A.; Scotti, S.J. (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). 30 Jun 1980. 39p. NTIS, PC A03/MF A01.

This work summarizes the work performed during the contract period. The goal was the development of quantitative disturbed-time magnetic and electric field in the magnetosphere. The July 29, 1980 event was the model disturbance used to develop a realistic magnetic and electric field model for a disturbed period.

11722 (AD-A—086728) Auroral electrodynamics I: 1. preliminary electron density profile and 2. vehicle potential changes during an active beam experiment. Memorandum report. Walker, D.N.; Holmes, J.C.; Szuszczewicz, E.P. (Naval Research Lab., Washington, DC (USA)). 19 May 1980. 16p. NTIS, PC A02/MF A01.

The report presents preliminary findings obtained by a pulsed plasma probe aboard a payload launched by a Terrier-Malemute sounding rocket from the Poker Flat Research Range. Results are outlined both during passive and active (i.e., an Argon plasma gun) experiments. Modifications to the design of the pulsed probe circuitry which allow tracking of the vehicle potential are described. The vehicle potential deduced from the analog records is plotted during times of interest (gun pulsing periods). An electron density profile with gun pulsing times indicated is also provided.

11723 (AD-A—086732) Experiments on the junction of relativistic electron beams into preformed channels in the atmosphere: a feasibility study. Memorandum report. Raleigh, M.; Sethian, J.D.; Fiorito, R.B.; Allen, L.; Fernsler, R.F. (Naval Research Lab., Washington, DC (USA)). 13 May 1980. 49p. NTIS, PC A03/MF A01.

A study was made of the interaction of an intense relativistic electron beam (REB) with a preformed reduced density channel in the atmosphere. The channel was designated by laser-induced, aerosol-initiated air-breakdown and was heated by passage of an electric current. However, at the time the REB was injected into the channel no externally applied heating current remained. By varying the time between creation of the hot channel and injection of the REB, we were able to observe interactions of the beam with both high conductivity and low conductivity channels. In the former case the beam did not propagate in the channel, whereas in the latter case the beam did propagate in the channel. These results are discussed in terms of the residual conductivity in the channel, and in terms of the radius of the return current distribution compared to that of the beam.

11724 (AD-A—086789) Influence of magnetic shear on the current convective instability in the diffuse aurora. Memorandum report. Huba, J.D.; Ossakow, S.L. (Naval Research Lab., Washington, DC (USA)). 16 Apr 1980. 23p. NTIS, PC A02/MF A01.

The influence of magnetic shear on the current convective instability is investigated for conditions typical of the high latitude F region during the diffuse aurora. It is found that magnetic shear (1) reduces the growth rate of the instability (although it does not stabilize the mode); and (2) substantially localizes the mode structure parallel to the density gradient.

11725 (AD-A—086837) Spectral analysis of scintillation data taken from an aircraft. Part I. Final report Oct 76-Oct 79. Barrett, T.B. (Parke Mathematical Labs., Inc., Carlisle, MA (USA)). Feb 1980. 83p. NTIS, PC A05/MF A01.

This report provides theoretical background material for the development of a thin phase screen model for radio scintillation. This model is then used to derive an expression for the expected amplitude scintillation spectra (spectral density funciton) which might be observed in a geometry which includes a satellite based transmitter, an aircraft based receiver and a 'thin', intermediate scintillation-producing medium. A computer procedure was developed for testing the model under various geometries and for various parameters describing the 'bulk' properties statistical properties of the medium. In addition to the development of a theoretical model, this report includes material on experimental spectral analysis and, in particular, details on a spectral analysis procedure which was used on amplitude scintillation and data gathered from an aircraft in geomagnetic equatorial regions.

11726 (AD-A—086868) Condensed storage of diffusion equation solutions for atmospheric density model computations. Bass, J.N. (Minnesota State Planning Agency, St. Paul (USA). Power Plant Siting Div.). 25 Jan 1980. 14p. NTIS, PC A02/MF A01.

It is shown that all neutral thermospheric component densities in diffusive equilibrium can be derived from a single function of height. This is used to permit considerable savings in storage of Jacchia 1977 model densities compared to storing the solution for each component, which requires use of external random access files. The single solution can be built into the computer code, making it more transportable to different computers. A subroutine has been developed implementing this method, including the latest results for atomic nitrogen and the non-diffusive equilibrium solution for atomic hydrogen.

11727 (AD-A—086998) Nonlinear evolution of diffuse auroral f region ionospheric irregularities. Memorandum report. Keskinen, M.J.; Ossakow, S.L.; McDonald, B.E. (Naval Research Lab., Washington, DC (USA)). 2 Jul 1980. 29p. NTIS, PC A03/MF A01.

Numerical simulations of the nonlinear evolution of the current convective instability in the diffuse aurora have been performed for conditions typical of the nighttime high latitude F region. Our results show nearly field aligned plasma irregularities developing in regions of well-defined northward gradients of total electron content (TEC) and field-aligned diffuse auroral particle precipitation. In addition, we find equatorward movement of plasma enhancements and northward (poleward) movement of plasma depletions (holes). Furthermore, one-dimensional spatial power spectra of the irregularities in both the north-south and east-west directions are well described by inverse laws.

11728 (AD-A—087011) Modelling of equatorial phase and amplitude scintillations from OGO-6 and irregularity data. Scientific report No. 1, 1 Mar 78-28 Feb 79. Basu, S.; Basu, S. (Emmanuel Coll., Boston, MA (USA)). Nov 1979. 29p. NTIS, PC A03/MF A01.

The technique of modelling equatorial phase and amplitude scintillations from in-situ measurements of irregularity amplitude, ambient ionization density and irregularity power spectrum is outlined. The in-situ measurements do not directly provide information on irregularity layer thickness for which radar backscatter observations are utilized. The equatorial scintillation models developed from OGO-6 and AE-C in-situ measurements during the two solstices are presented. Considerable differences in the longitude variation of scintillations are predicted during the two solstices. The model estimates are in good agreement with the available ground based phase and amplitude measurements. Problems associated with the use of bottomside spread-F data for transionospheric propagation modelling at VHF/UHF are also discussed.

11729 (AD-A—087208) Quasilinear scattering from waves driven by beam-plasma instabilities. Memorandum report. Brecht, S.H.; Palmadesso, P.J. (Naval Research Lab., Washington, DC (USA)). 21 Apr 1980. 36p. NTIS, PC A03/MF A01.

The Starfish southern conjugate rebrightening is explained by velocity diffusion perpendicular to the earth's magnetic field line. The diffusion is caused by particle scattering off of the harmonics of ion cyclotron waves commonly called Bernstein modes. Quasilinear estimates of the wave fluctuation levels indicate that the debris streaming down the field lines will excite these waves and then be scattered by them.

11730 (AD-A—087259) Ionospheric modeling and propagation analysis. Final technical report Nov 76-sSep 79. Miller, D.C.; Gibbs, J. (Arcon Corp., Wakefield, MA (USA)). Apr 1980. 75p. NTIS, PC A04/MF A01.

This report describes several studies and the development of computer techniques toward improving the capability of predicting and assessing HF propagation through the ionosphere. These studies included the development of vertical electron density models which can accurately represent observed oblique and vertical ionograms. These models have been represented by a series of functions which describe the individual ionospheric layers and which are analytically integratable to yield expected ray path trajectories. A computer program has been written which incorporates these features and yields results which are two orders of magnitude faster than those available using conventional numerical ray tracing techniques. The technique has been applied to several studies including the simulation of the backscatter leading edge of oblique ionograms and the determination of HF circuit parameters for a specified ground coverage. The results are presented as a function of the change in individual ionospheric layer parameters.

11731 **(AD-A—087404) Equatorial scintillation of satellite signals at uhf and l-band for two different elevation angles. Technical report 1 Jan 79-1 May 80.** Paulson, M.R. (Naval Ocean Systems Center, San Diego, CA (USA)). 1 May 1980. 182p. NTIS, MF A01.

An investigation of the equatorial scintillation of satellite signals at uhf and L-band for 10-and 50-degree elevation angles is reported. diurnal and seasonal variations of scintillation, as well as solar cycle dependence, are given. The occurrence and intensity of scintillations are compared for the two frequencies and for the two elevation angles. A number of fade duration distributions for fades greater than 6 and greater than 12 dB below the undisturbed signal are shown for each frequency and each satellite. A periodicity in the occurrence of scintillation is reported and is attributed to the gravitation field of the moon. It is proposed that the moon's gravity affects the occurrence and intensity of equatorial scintillation by modulating the velocity of the zonal winds at ionospheric heights.

11732 **(AD-A—087433) The investigation of the magnetospheric dynamics in conjunction with the scatha satellite observations. Final report 1 Oct 78-30 Sep 79.** Meng, Ching-I. (Johns Hopkins Univ., Silver Spring, MD (USA). Applied Physics Lab.). Dec 1979. 138p. NTIS, MF A01.

This task consists of two parts. The first part concerns (a) the collection and analysis of ground-based and satellite data for the purpose of monitoring the magnetospheric conditions in support of the SCATHA satellite activity at Air Force Geophysics Laboratory, and (b) the technical support in the study of the particle and field data returned by SCATHA satellite. The second part is to analyze observations of auroral phenomena made by satellites of the USAF Defense Meteorological Satellite Program. The effort at APL/JHU for the first part of this task was majorly in the role of providing supports to the SCATHA activity and for the second part of DMSP observations was in the understanding of polar region auroral phenomena. Therefore, this final report is divided into a summary of efforts supporting SCATHA and scientific results from analyzing DMSP data. The former consists of (1) a short description of why and how the ground-based magnetic data can be used in monitoring the magnetospheric conditions and (2) a list of data collected together with a guide for using these data. The latter contains (1) a list and abstracts of all scientific reports and journal articles published or submitted for publication, during this reporting period, with at least partial sponsorship attributed to AFGL, and (2) an article concerning a possible diurnal variation of the auroral oval size.

11733 **(PB—80-194277) ATS-6 radio beacon electron content measurements at Ootacamund, India, October 1975-July 1976.** Bouwer, S.D.; Davies, K.; Donnelly, R.F.; Grubb, R.N.; Jones, J.E. (World Data Center A for Solar-Terrestrial Physics, Boulder, CO (USA)). Mar 1980. 59p. NTIS, PC A04/MF A01.

An atlas of total slant-path columnar electron content data measured between the ATS-6 satellite and Ootacamund, India, a site near the magnetic Equator is presented. Although these measurements were taken during a solar minimum, the general level of flare and geomagnetic activity that occurred during the observation period is summarized. These total content (N(T)) data were derived from the modulation phase (group delay) of a carrier signal transmitted from the geostationary satellite's Radio Beacon Experiment. This atlas contains two data sets: (1) N(T) as 2-min subsamples digitally recorded between 2 October 1975 and 28 January 1976 corrected for ATS-6 pitch maneuvers and (2) N(T) as 15-min subsamples chart recorded between 21 October 1975 and 22 July 1976 but uncorrected for changes in satellite orientation.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 11778, 11779, 11809, 11812

11734 **(AD-A—086072) Thermally produced population inversions and their consequences. Final report 1 Jan 77-18 Jan 80.** Berry, R.S. (Chicago Univ., IL (USA)). 30 May 1980. 7p. NTIS, MF A01.

Alkali halide molecules dissociated by shock waves in gases exhibit population distributions far from equilibrium. The kinetics of the subsequent chemical relaxation have been worked out and the rate coefficients have been determined for many of these ionic molecules. In some cases, the nonequilibrium populations are highly inverted, and in at least two systems, the inverted population has been used to produce light amplification (lasing action) with spectral lines in the visible region.

11735 **(AD-A—086347) Inversion of spectral lineshapes to yield collisional rate constants. Status report No. 1, 1 Sep 78-31 Aug 80.** Gelfand, J.; Rabitz, H.; Miles, R.B. (Princeton Univ., NJ (USA). Dept. of Mechanical and Aerospace Engineering). 1 Jun 1980. 13p. NTIS, PC A02/MF A01.

State-to-state collisional energy transfer rates are being obtained by the inversion of pressure broadened linewidth data. Measurements of linewidths in overtone vibration-rotation transitions have yielded information rotationally elastic and inelastic collision rates for vibrationally excited HCl. Work is continuing in acquiring similar information for vibrationally excited HF and DF using tunable laser photoacoustic spectroscopy.

11736 **(AD-A—086497) Studies of laser selective excitation of atoms.** Drewell, N. (Toronto Univ., Ontario (Canada). Inst. for Aerospace Studies). Dec 1979. 150p. NTIS, MF A01.

Sample preparation through laser ablation of a solid target under vacuum has been combined with short-pulsed laser selective excitation to create a new and convenient experimental technique for measuring atomic radiative lifetimes. The lifetimes of the three resonance states of chromium determined in this way compare very favourably with those found through other experimental means. In addition, the technique has been extended to demonstrate experimentally the potential for plasma diagnostics using two-wavelength selective excitation with short laser pulses. The ratio of population densities of two energy states of chromium atoms has been measured as a function of time during the expansion of the ablation plasma. Extended saturation pumping of the resonance transition in sodium vapour has been investigated theoretically. Rate equations for 20 energy levels in the sodium atom, and the rate equations for the free electrons, were integrated numerically. It has been found that multiphoton ionization, combined with superelastic heating of free electrons can account for the rapid and complete ionization of an un-ionized vapour, as reported in the literature. The detailed theoretical results have led to the development of a simple model which accurately predicts the temporal variation of electron density.

11737 **(AD-A—086662) Quantum mechanical studies of molecular hyperpolarizabilities. Final technical report.** (Battelle Columbus Labs., OH (USA)). 30 Apr 1980. 68p. NTIS, PC A04/MF A01.

The objectives of this effort are threefold: (I) Develop state-of-the-art quantum mechanical methods to predict, from first principles, hyperpolarizabilities of atoms and molecules; (II) Determine why previous theoretical calculations have not been able to even provide order of magnitude estimates of experimental hyperpolarizabilities; and (III) Apply the quantum mechanical techniques developed in this work to predict hyperpolarizabilities and non-linear susceptibilities for a number of atoms and molecules of interest. This effort will provide complementary information to ongoing experimental efforts directed toward obtaining hyperpolarizabilities.

11738 **(AD-A—087210) Electron ionization cross sections in the distorted-wave approximation. Memorandum report.** Blaha, M.; Davis, J. (Naval Research Lab., Washington, DC (USA)). 18 Jun 1980. 52p. NTIS, PC A04/MF A01.

Eight different modifications (A1-A8) of the distorted-wave approximation for the calculation of electron ionization cross sections are introduced and results are compared with other theoretical methods and experiment. Non-exchange approximations (A1-A4) are characterized by different orthogonal properties of wave functions and by different choices of asymptotic charges for the ejected electron. Results of these approximations are compared for H, He, He(+), Li(+), and Mg(+). The best approximation (A4) is then used for more complex atomic systems such as Li, C(+3), C(+), N(+), O(+), O, Ne(+), Na(+), and K(+). A4 generally

agrees better with experiment than the Born or Coulomb-Born approximation. Exchange approximations (A5-A8) are characterized by different choices of asymptotic charges in the exchange amplitude. These approximations have been tested on hydrogen and although a slight improvement over the non-exchange approximations has been obtained in the case of A5, the difference does not appear to be too significant.

11739 **(AD-A—087278) Investigation of electron attachment in polyatomic molecules. Final report 1 Apr 77-31 Mar 80.** Dowell, J.T. (IRT Corp., San Diego, CA (USA)). 30 May 1980. 61p. NTIS, PC A04/MF A01.

Electron attachment to polyatomic molecules was studied using molecular beams of variable temperature crossed with an electron of high energy resolution. Species investigated include sulfur hexafluoride, molybdenum hexafluoride, and tungsten oxide polymers. New results were obtained in sulfur hexafluoride demonstrating importance of internal energy for the dissociative attachment in molybdenum hexafluoride. Tungsten oxide vapor exhibits both monomer and dimer negative ion formation near zero energy, apparently from dissociative attachment to the trimer.

11740 **(DOE/ER/02184—48) Studies of muon capture and hydrogen transfer mechanisms. Progress report, January 1-December 1980.** Naumann, R.A. (Princeton Univ., NJ (USA)). 1980. Contract AS02-76ER02184. 13p. NTIS, PC A02/MF A01.

Research during 1980 in the area of muon capture is briefly sketched. All completed work has been or will be published. No data are given in this report. (RWR)

11741 **(DOE/ER/03518—94) Study of defects, radiation damage and implanted gases in solids by field-ion and atom-probe microscopy.** Seidman, D.N.; Amano, J.; Wagner, A. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering; Cornell Univ., Ithaca, NY (USA). Materials Science Center). Oct 1980. Contract AS02-76ER03158. 21p. NTIS, PC A02/MF A01.

The ability of the field-ion microscope to image individual atoms has been applied, at Cornell University, to the study of fundamental properties of point defects in irradiated or quenched metals. The capability of the atom probe field-ion microscope to determine the chemistry - that is, the mass-to-charge ratio - of a single ion has been used to investigate the behavior of different implanted species in metals. A brief review is presented of: (1) the basic physical principles of the field-ion and atom-probe microscopes; (2) the many applications of these instruments to the study of defects and radiation damage in solids; and (3) the application of the atom-probe field-ion microscope to the study of the behavior of implanted ^{3}He and ^{4}He atoms in tungsten. The paper is heavily referenced so that the reader can pursue his specific research interests in detail.

11742 **(LBL—11720) Auger electron spectroscopy.** Somorjai, G.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1980. Contract W-7405-ENG-48. 45p. (CONF-801238—1). NTIS, PC A03/MF A01.

From EXXON conference on surface science; Linden, NJ, USA (4 Dec 1980).

A review of Auger electron spectroscopy is presented. Methods, resolution, sensitivity, and uses are discussed. 30 references, 10 figures. (GHT)

11743 **(LBL—12110) Circular Intensity Differential Scattering of chiral molecules.** Bustamante, C.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1980. Contract W-7405-ENG-48. 292p. NTIS, PC A13/MF A01.

Thesis.

In this thesis a theory of the Circular Intensity Differential Scattering (CIDS) of chiral molecules as modelled by a helix oriented with respect to the direction of incidence of light is presented. It is shown that a necessary condition for the existence of CIDS is the presence of an asymmetric polarizability in the scatterer. The polarizability of the scatterer is assumed generally complex, so that both refractive and absorptive phenomena are taken into account.

11744 **Charged particle beam processing with magnetic field compensation.** Konig, D.; Moench, C.; Scheffels, W.; Steigerwald, K.H. (to Steigerwald Strahltechnik Gmbh (Germany)). US Patent 4,223,200. 16 Sep 1980. vp.

A device for compensating for spurious magnetic fields in an energy beam device includes first and second pairs of electromagnetic poles arranged along the particle path and providing magnetic fields to compensate for spurious magnetic fields which might cause the beam of charged particles to deviate from the desired beam path.

6404 Fluid Physics

11745 **(SAND—80-8240) Mass, momentum and energy conservation equations in generalized curvilinear coordinates: equation development and a proposed solution technique.** Mitchell, R.E. (Sandia National Labs., Livermore, CA (USA)). Jan 1981. Contract AC04-76DP00789. 30p. NTIS, PC A03/MF A01.

The equations that characterize the flow of a viscous, compressible reactive gas mixture are presented in generalized curvilinear coordinates. The equations allow the physical laws that govern the transport of mass, momentum, and energy within a system to be described in a coordinate frame best suited to characterize the boundaries of the problem of concern. The equations feature certain nonlinearities that make the set of coupled, partial differential equations impossible to solve analytically. A numerical procedure is presented that employs the latest developments in implicit algorithms when solving the time-dependent forms of the governing equations. 3 tables.

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 11771, 11788

11746 **(AD—220670) An accurate determination of the micron + magnetic moment.** Garwin, R.L.; Hutchinson, D.P. (Columbia Univ., Irvington-on-Hudson, NY (USA). Nevis Labs.). Jul 1959. 10p. NTIS, MF A01.

Using a precession technique, the magnetic moment of the positive micron meson is determined to an accuracy of 0.007%. Muons are brought to rest in a bromoform target situated in a homogeneous magnetic field, oriented at right angles to the initial muon spin direction. The precession of the spin about the field direction, together with the asymmetric decay of the muon, produces a periodic time variation in the probability distribution of electrons emitted in a fixed laboratory direction. The period of this variation is compared with that of a reference oscillator by means of proton measurements of the beat note. The magnetic field at which the precession and reference frequencies coincide is measured with reference to a proton nuclear magnetic resonance magnetometer. The ratio of the muon precession frequency to that of the proton in the same magnetic field is determined to be 3.1834 + or - 0.002. Using a re-evaluated lower limit to the muon mass, a lower limit is yielded on the muon g-factor of 2 (1.00122 + or - 0.00008), in agreement with the predictions of quantum electrodynamics.

11747 **(AD—463449) Photoproduction of $\pi 0$ from hydrogen near the second pion nucleon resonance.** De Staebler, H. Jr; Erickson, E.F.; Hearn, A.C.; Schaerf, C. (Stanford Univ., CA (USA). High-Energy Physics Lab.). Feb 1965. 51p. NTIS PC04/MF A01.

Pion photoproduction from nucleons has proved a useful tool in the study of the pion-nucleon interaction because of the dominance of the strong final-state interaction between emitted pion and recoil nucleon. There has remained, however, a noticeable lack of data at high momentum transfer in the region of the second pion-nucleon resonance. In particular, the zero angle measurement provides an important test of the hypothesis that the direct photoelectric term is responsible for the difference in position of this resonance in π^0 and π^{+-} photoproduction. The present experiment was designed to study this region using the Stanford Mark III linear accelerator. The results of the experiment establish that the

discrepancy in resonance positions is not due to the photo-electric term, and also establish the possibility of a high momentum transfer enhancement of π^0 photoproduction caused by crossed nucleon and nucleon isobar exchanges. The paper is divided into into five parts. In Section II, the experimental equipment and techniques are described. Section III contains an account of the data reduction, and the results are then interpreted in Section IV. Finally, in Section V, general conclusions are drawn.

11748 **(AD—468909) Elastic electron deuteron scattering and possible meson-exchange effects.** Buchanan, C.D.; Hearian, M.R. (Stanford Univ., CA (USA). High-Energy Physics Lab.). May 1965. 10p. NTIS, MF A01.

Data on elastic electron-deuteron scattering is obtained using a two-spectrometer coincidence-detection technique. Preliminary analysis of the data has been compared with an impulse approximation theory and has enabled the investigation of possible meson-exchange and/or relativistic effects. The measurements were made using a 1.2 cm thick liquid deuterium target and two 180 degree N=1/2, double-focusing magnetic spectrometers. Deuterons were deflected by a 72-inch, 100 MeV/c spectrometer and detected by a six-channel ladder of plastic scintillators. Electrons were deflected by a 36-inch, 550 MeV/c spectrometer and detected by a similar five-channel ladder with a liquid Cerenkov backing counter. The solid angle was defined by the 36-inch spectrometer. By demanding a coincidence between counts from each spectrometer, background events from competing inelastic processes were eliminated. Delayed accidental coincidence rates were monitored.

11749 **(DOE/ER/02232—T1) Experimental studies of elementary particle interactions at high energies. Technical progress report.** (Rockefeller Univ., New York (USA)). Jan 1981. Contract AC02-76ER02232. 20p. NTIS, PC A02/MF A01.

During 1980, the research program in experimental high energy physics at The Rockefeller University has made substantial contributions to the understanding of both strong and weak interactions. The principal Laboratories which have been utilized in this work are the 500 GeV accelerator at Fermilab and the Intersecting Storage Rings facility at CERN. The latter is a facility unique in the world which provides the highest available energies for proton-proton collisions. The results of the individual experimental projects obtained during 1980 are described in some detail.

11750 **(DOE/ER/05223—33) Existence of dibaryon resonances in I = 1 $^1D_2$ and $^3F_3$ nucleon-nucleon scattering.** Bhandari, R.; Arndt, R.A.; Roper, L.D.; VerWest, B.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Physics; Texas A and M Univ., College Station (USA). Dept. of Physics). Aug 1980. Contract AS05-76ER05223. 20p. NTIS, PC A02/MF A01.

Recent, precise analyses of p-p and n-p scattering data up to 800 MeV by the VPI & SU-TAMU-MSU group has provided the strongest evidence to date for the existence of dibaryon states in the I = 1 $^1D_2$ and $^3F_3$ nucleon-nucleon channels. Model fits to their new phases reveal poles located near the NΔ threshold ((2.15 to i.05) GeV). Because of their strong coupling to this channel, these dibaryon resonances are highly inelastic.

11751 **(LBL—11844) Virtual photoproduction of hidden and open charm.** Clark, A.R.; Johnson, K.J.; Kerth, L.T. (Marquette Univ., Milwaukee, WI (USA). Dept. of Chemistry). Nov 1980. Contract W-7405-ENG-48. 39p. (CONF-800782—1). NTIS, PC A03/MF A01.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

The Berkeley-Fermilab-Princeton multimuon spectrometer and the techniques used to analyze the data which it has collected are described first. Limits on the cross section with which possible heavy neutral or doubly charged muons are produced via right-handed charged currents are presented. Turning to heavy-quark muoproduction, the author then outlines the relevant phenomenology, emphasizing the predictions of the vector dominance (VMD) and photon-gluon-fusion models. The first heavy-quark data discussed are the dimuon-mass spectrum observed in trimuon final states, which provides a limit on muoproduction of the Y family. The bulk of the quarkonium results are devoted to J/psi(3100) muoproduction. After briefly reviewing the original psi results, the author focuses on a combined analysis of the polarization and Q^2 dependence of elastically produced psi's. The remainder of the paper is devoted to the muoproduction of open charm, observed in events with two muons in the final state. 57 references, 11 figures, 3 tables. (RWR)

11752 **Study of the reaction anti $\nu p \rightarrow \mu^+ p\pi^-$.** Barish, S.J.; Brock, R.; Engler, A.; Kikuchi, T.; Kraemer, R.W.; Messing, F.; Stacey, B.J.; Tabak, M. (Pittsburgh Univ., PA (USA)); Derrick, M.; Gregory, P. (Argonne National Lab., IL (USA)). *Physics Letters, [Section] B ;* **91**: No. 1, 161-164(Mar 1980).

We present data on the reaction anti $\nu p \rightarrow \mu^+ p\pi^-$ from an exposure of the Fermilab 15 ft hydrogen bubble chamber. The channel cross section for 5 GeV < E/sub anti ν/ < 70 GeV and M($p\pi^-$) < 1.9 GeV is sigma = (27 +- 5) x 10^{-40} cm^2. This cross section is dominated by the I = 1/2 production amplitude.

11753 **Precise measurement of GAMMA ($\Lambda 0 \rightarrow p + e^- +$ anti nu)/GAMMA($\Lambda^0 \rightarrow p + \pi^-$).** Wise, J.; Jensen, D.A.; Kreisler, M.N.; Lomanno, F.; Poster, R.; Rabin, M.S.Z.; Raychaudhuri, K.; Way, M. (Massachusetts Univ., Amherst (USA). Dept. of Physics and Astronomy); Humphrey, J. (Brookhaven National Lab., Upton, NY (USA)). *Physics Letters, [Section] B ;* **91**: No. 1, 165-168(Mar 1980).

Based on a sample of 10 000 events of the decay $\Lambda^0 \rightarrow p + e^-$ + anti ν, the ratio GAMMA($\Lambda^0 \rightarrow$ pe anti ν)/GAMMA($\Lambda^0 \rightarrow p\pi^-$) is found to be (1.313 +- 0.024) x 10^{-3}. From this, the absolute rate for the process is calculated to be (3.204 +- 0.068) x $10^6 s^{-1}$.

11754 **New search for the allowed decay $\pi 0 \rightarrow 4\gamma$.** Auerbach, L.B.; Haik, N.; Highland, V.L.; McFarlane, W.K. (Temple Univ., Philadelphia, PA (USA). Dept. of Physics); Macek, R.J.; Pratt, J.C.; Sarracino, J.; Werbeck, R.D. (Los Alamos Scientific Lab., NM (USA)). *Physics Letters, [Section] B ;* **90**: No. 3, 317-318(Feb 1980).

A new search with increased detection efficiency has been made for the decay of the neutral pion into four photons, an allowed decay which is expected to be rare. We have observed no events, placing an upper limit in the branching ratio of 4.4 x 10^{-6} at 90% confidence level.

11755 **Inclusive production of neutral strange particles by 147 GeV/cπi/K^+/p interactions in hydrogen.** Brick, D.; Shapiro, A.M.; Widgoff, M. (Brown Univ., Providence, RI (USA)); Ansorge, R.E.; Carter, J.R.; Neale, W.W.; Rushbrooks, J.G.; Ward, D.R.; Whyman, B.M. (Cambridge Univ. (UK)); Burnstein, R.A. (Illinois Inst. of Tech., Chicago (USA)). *Nuclear Physics, [Section] B ;* **164**: No. 1, 1-24(Feb 1980).

Results are presented from a study of inclusive neutral strange particle production by a 147 GeV/c tagged π^+/K^+/p beam in the Fermilab 30-inch hydrogen bubble chamber. The experiment made use of the proportional hybrid spectrometer system. Results are based on 995 K°/sub S/, 485 Λ, and 83 anti Λ found in a sample of 132 000 pictures. Cross sections are given for inclusive production of these particles by each of the three beam particles, and comparisons are made with measurements at other energies. Topological cross sections are also calculated, and KNO multiplicity scaling is investigated. Distributions are presented of invariant cross sections as functions of the Feynman scaling variable x and c.m. rapidity y. The transverse momentum-squared distributions with their fitted slopes are also given. Comparisons are made of the production characteristics for the three beam types.

11756 **Correlations of high transverse momentum $\pi 0$ pairs produced at the CERN ISR.** Kourkoumelis, C.; Resvanis, L.K. (Athens Univ. (Greece)); Filippas, T.A.; Fokitis, E. (National Technical University, Athens, Greece); Cnops, A.M.; Iwata, S.; Palmer, R.B.; Rahm, D.C.; Rehak, P.; Stumer, I. (Brookhaven National Lab., Upton, NY (USA)). *Nuclear Physics, [Section] B ;* **158**: No. 1, 39-56(8 Oct 1979).

Correlations of two π^0 mesons with transverse momenta up to 10 GeV/c have been measured utilizing apparatus with large azi-

muthal acceptance. The data are analyzed in the context of constituent scattering models, and also compared with a simple 'background' hypothesis.

11757 Pion induced deuteron breakup studies at 350 MeV/c. Hoftiezer, J.H. Houston, TX; Rice Univ. (1979). 143p. University Microfilms Order No. 79-19,594.
Thesis (Ph. D.).
Experimental studies of the pion-induced deuteron breakup processes d(π^{+-},pπ^{+-})n have been carried out using 350-MeV/c pions in the LAMPF P^3 channel. Data were collected at eleven spectrometer settings, in the region near the peak of the pion-proton subsystem $\Delta(1236)$ resonance and in regions away from this peak. The kinematically complete counter experiment covers a range of spectator neutron momentum from 0 to approximately 200 MeV/c. Fifth-order differential cross sections were determined for all settings. Comparison of π^+ to π^- data shows the expected difference ratio (9:1) at low spectator momentum, but the ratio has interesting deviations at large values. One-nucleon-exchange-model calculations yield qualitative agreement with the data, but indicate the necessity of higher-order processes in a complete theoretical description. Results of the experiment have stimulated interest in working out such a detailed theory.

11758 Pion production from the p(d;dπ)n reaction at 800 MeV with spectator neutron momenta between 0 MeV/c and 400 MeV/c. Judd, D.M. Houston, TX; Rice Univ. (1979). 169p. University Microfilms Order No. 79-19,599.
Thesis (Ph. D.).
Fifth-order differential cross sections, $d^5\sigma/dp/sub\ D/d\Omega/sub\ D/dO/sub\ \pi/$, have been measured for the d(p;dπ^+)n reaction in a kinematically complete experiment. These measurements were made with the 800-MeV proton beam from the Los Alamos Meson Physics Facility (LAMPF) in Los Alamos, New Mexico. The deuterons were detected in a magnetic spectrometer arm in coincidence with the pions, which were detected in a time-of-flight arm. The deuterons were detected over the angular range $15^0 < \theta/sub\ D/ < 35^0$, the pions were detected over the range $20^0 < \theta/sub\ \pi/ < 41.7^0$, and the neutrons remained as spectators. Because the deuteron is an isospin-zero particle, the d(p;dπ^+)n reaction can proceed without the $\Delta(3/2,3/2)$ resonance formed in the final state. This allows the study of pion production using the one-nucleon exchange (ONE) spectator model for kinematic conditions here the pp $\rightarrow$ dπ^+ reaction is the pion-producing mechanism. To obtain these conditions, the angle pairs were chosen so that for a given deuteron angle the corresponding pion angle gave the absolute minimum momentum to the spectator neutron. These angle pairs allowed the study of pion production for a range of neutron spectator momenta from 0 MeV/c, where the ONE model is known to fit the data, to 400 MeV/c, where the model is known to fail. This allowed the study of the pion production mechanism as a continuous function of spectator momentum.

11759 Proton deuteron elastic scattering from 20 to 220 GeV/c. Warren, G.D. Rochester, NY; Univ. of Rochester (1979). 114p. University Microfilms Order No. 79-22,969.
Thesis (Ph. D.).
Proton deuteron elastic scattering was studied with facilities available at the Internal Target Area of the Fermi National Accelerator Laboratory. A deuteron gas jet was the target, and the recoil deuterons were detected at large angles from the forward direction with a spectrometer employing a superconducting dipole and quadrupole doublet. A total of 5×10^5 recoil deuterons were recorded for incident momenta, p/sub o/, from 20 to 220 GeV/c and with four-momentum-transfer squared, t, in the range $0.6 < -t < 3.0$ $(GeV/c)^2$. From these, approximately 150 differential cross sections were obtained covering the t and p/sub o/ region as evenly as possible. The results disagree with simple Glauber model predictions, and are typically significantly less than the predictions. The bulk of the data can be understood by adding corrections for the space-time development of the strong interaction to the Glauber model. In this context, the time constant of the strong interaction and its dependence on t was measured. Explanations based upon the addition of intermediate inelastic states to the Glauber model do not reasonably explain the data, either quantitatively or even qualitatively.

11760 Two-photon reaction in electron-positron colliding beams. Sullivan, M.K. San Diego, CA; Univ. of California (1979). 155p. University Microfilms Order No. 79-21,500.
Thesis (Ph. D.).
The 2-photon process has been studied at SPEAR with beam energies of 3.0 and 3.6 GeV. The integrated luminosity was 10 pb^{-1}. In all events both the electron and positron that produced the event were detected. Hexagonal NaI crystals were used to measure the energy of the electron and positron. A charged track detector with 93% solid angle coverage observed a total of 20 events with 2 charged particles near the mass of the f(1270) and the eta'. The conclusions reached were that the $\gamma\gamma$ width of the f is 7.0 +- 2.1 keV, and that the data are not inconsistent with the predicted $\gamma\gamma$ width of 6.3 keV for the eta'. In addition, 25 pion events and 25 muon events were detected in a smaller region of solid angle: the ratio of pion events to muon events (R/sub $\gamma\gamma$/) could thus be calculated. The value of R/sub $\gamma\gamma$/ obtained was 1.0 +- 0.34. This value is in closer agreement with the prediction of the fractionally charged quark model than with the prediction of the integrally charged quark model. However, these predictions may not be applicable in the Q^2 range of this experiment.

11761 Resonant and continuum production of massive muons pairs in 400 GeV proton-nucleus collisions. Kaplan, D.M. Stony Brook, NY; State Univ. of New York (1979). 189p. University Microfilms Order No. 79-16,878.
Thesis (Ph. D.).
An experiment to measure the yield of muon pairs above 5 GeV mass in 400 GeV proton-nucleus collisions is described in detail. Apparatus used, running conditions, backgrounds, and corrections to the data are discussed. Results are presented and interpreted in terms of the quark-parton model and quantum chromodynamics (QCD). The production of a new family of narrow $\mu^+\mu^-$ resonances, dubbed T, is observed. Dependence of the muon-pair cross section on nucleon number, mass transverse momentum, and rapidity is presented, and differences in the production dynamics of the resonances and the continuum are emphasized. Various possible interpretations of the T are discussed, and the most likely one - that the T's are bound states of a new, heavy, charge - 1/3 quark with its antiquark - is elucidated. The continuum is interpreted in terms of the parton annihilation model of Drell and Yan modified by QCD corrections. Momentum distributions of antiquarks in the nucleon are extracted. The problem of large muon pair transverse momentum is discussed. The spectrum of single muons arising from massive muon-pair production is computed.

6452 Particle Interactions And Properties - Theoretical

11762 (BNL—28825) Theoretical implications on ISABELLE physics. Wang, L.L.C. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 44p. (CONF-800778—3). NTIS, PC A03/MF A01.
From 18. course: the high energy limit; Erice, Trapani, Italy (31 Jul 1980).
A brief historical review of the development of understanding of the weak interaction and its final unification with electromagnetic theory is given first. Then the production cross sections of W^{+-} and Z^0 in hadronic scatterings are estimated; CVC, scaling, Drell-Yan model, structure functions and perturbative QCD, σ/sub w/, σ/sub z/, and production rate are aspects considered. Next, the detection of the Z^0 and W^{+-} in leptonic decay and hadronic decay is discussed, along with some detail features of the Drell-Yan model. Then an estimate of the onia production is given, and the Higgs boson and the technicolor pseudoscalar production are considered. In conclusion, anticipated work in these areas at ISABELLE is summarized. 48 references, 14 figures, 2 tables. (RWR)

11763 New relation among neutrino neutral current couplings and a constraint on the electron weak neutral current couplings. Sidhu, D.P. (Brookhaven National Lab., Upton, NY (USA)). *Physics Letters, [Section] B ;* **87**: No. 1-2, 67-68(22 Oct 1979).
A new relation among the neutrino neutral current couplings to quarks and leptons is discussed. The relation permits a more direct test of the fermionic assignments in the Weinberg-Salam SU(2)sub(L)xU(1) model and SU(2)sub(L)xSU(2)sub(R)xU(1)

models. This relation together with a relation derived by Bernabeu and Jarlskog (1977) allows a unique determination of neutrino electron weak neutral current couplings.

11764 (DOE/ER/01545—299) QCD anomaly mediation of psi′ → psiπ^0 and psi′ → psi eta. Milton, K.A.; Palmer, W.F.; Pinsky, S.S. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1981. Contract AC02-76ER01545. 6p. NTIS, PC A02/MF A01.

Various decay processes mediated dominantly by pseudoscalar couplings to the QCD axial-vector anomaly are discussed. Coupling strengths of earlier calculations are used to compute psi′ → π^0 psi/psi′ → eta psi, obtaining good agreement with experiment. (GHT)

11765 (DOE/ER/02978—6) Inelastic strong interactions at high energies. Annual progress report, June 1, 1980-May 1, 1981. Suranyi, P. (Cincinnati Univ., OH (USA)). Jan 1981. Contract AS02-76ER02978. 8p. NTIS, PC A02/MF A01.

The study of Grand Unified Field Theories was continued, concentrating on the symmetry breaking by Higgs bosons with the inclusion of single-gauge-loop corrections at both zero and nonzero temperature. The possible metastable phases of an SU(N) gauge theory broken by a Higgs boson of the adjoint representation are SU(r)xSU(N-r)xU(1) only. The phase diagram of broken SU(N) and O(2N) theories was displayed as a function of two renormalization-group-invariant parameters. All phase transitions were found to be first order and, at least in the Colemen-Weinberg regime, the phase diagram is completely different from that of the tree approximation; for example, several phase transitions may take place if the mass parameter (effectively the temperature) of the theory is decreased. Upper bounds were obtained for the phase-transition temperature in terms of the Higgs boson mass both for an SU(N) field theory with a Higgs boson in the adjoint representation and for the Glashow-Weinberg-Salam theory of electro-weak interactions. Finally, upper bounds were found for the masses of Higgs bosons in both of the above-mentioned types of theories in terms of the supercooling ratio, provided the expansion rate of the universe is too large and the tunneling rate is too small to complete the phase transition before the symmetric phase becomes unstable.

11766 (DOE/ER/05223—31) Three-body helicity formalism applied to pion-deuteron scattering. Garcilazo, H. (Texas A and M Univ., College Station (USA). Dept. of Physics). 1980. Contract AS05-76ER05223. 27p. NTIS, PC A03/MF A01.

Wick's three-body helicity formalism is applied to covariantly reduce the relativistic Faddeev equations that describe pion-deuteron elastic scattering, obtaining a set of equations that satisfy two and three-body unitarity and are Lorentz invariant with regard to both the space and the spin variables. All the pion-nucleon S and P-wave channels and the two nucleon-nucleon S-wave channels are used as input to give a good description of the data for pion kinetic energies in the region from 142 MeV upt o 512 MeV.

11767 (DOE/ER/05223—32) One-pion-exchange potential on the three-body model of nucleon-nucleon scattering. Garcilazo, H. (Texas A and M Univ., College Station (USA). Dept. of Physics). 1980. Contract AS05-76ER05223. 18p. NTIS, PC A02/MF A01.

The one-pion-exchange potential in the three-body model of nucleon-nucleon scattering is derived in which the nucleon is treated as a bound-state of a pion and a nucleon, and in the static limit it has the same form as the usual Yukawa OPEP derived from field theory, except that its range is energy dependent and it becomes complex above the pion-production threshold.

11768 (DOE/ER/05223—35) Intermediate-energy nuclear theory. Bryan, R.A.; VerWest, B.J.; Dominguez, C.A. (Texas A and M Univ., College Station (USA). Dept. of Physics). Dec 1980. Contract AS05-76ER05223. 32p. NTIS, PC A03/MF A01.

Investigations on the nucleon-nucleon interaction at medium energies are reported. A major program to extract the experimental scattering amplitudes from the NN data over the 0 to 850 MeV energy range was begun. Special subprograms were set up to handle the large amount of data involved, and to estimate the total reaction cross sections. A program to project out partial-wave amplitudes of a tree-graph model for NN → NNπ, in order to supplement the data in the higher angular momentum states, was completed. Work was also carried out on the three-body problem, particularly π-deuteron scattering, and on setting up an appropriate formalism for the two-to-three particle process NN → NNπ. In strong-interaction-related work, the pion-nucleon sigma term was investigated, and the dual-model prediction for factorizable three-hadron form factors was confirmed. Finally, a study of isospin as a dynamical operator in an extended space was continued. Individual summaries in this report are of only abstract length with no data. References are given.

11769 (DOE/ER/70004—262) Recombination model and baryon production by pp and πp collisions. Takasugi, E.; Tata, X. (Oregon Univ., Eugene (USA). Dept. of Physics; Texas Univ., Austin (USA). Dept. of Physics). 1979. Contract AT06-76ER70004. 18p. NTIS, PC A02/MF A01.

The recombination model predictions for baryon production, using modified Kuti-Weisskopf structure functions, are in good agreement with the pp and πp collision data. The indistinguishability of sea quarks naturally accounts for the difference in the p and anti p spectra in the pion fragmentation region. 4 figures, 2 tables.

11770 (DOE/ER/70004—273) Departure from Weinberg-Salam model and grandunification. Deshpande, N.G. (Oregon Univ., Eugene (USA)). 1980. Contract AT06-76ER70004. 6p. (RLO—2230-T4-273; CONF-800724—62). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

The spontaneous breaking of grandunified groups like SO(10) or SU(8) x SU(8) can lead to an extra U(1) group beyond Weinberg-Salam (W-S) SU(2) x U(1). Neutral current data are now shown to depend on two more parameters. The data are examined and limits are put on the mass of the extra Z boson. Need for more experiments on parity violation effects in atoms is stressed. 2 figures, 1 table.

11771 Polarization transfer in elastic electron scattering from nucleons and deuterons. Arnold, R.G. (American Univ., Washington, DC); Carlson, C.E.; Gross, F. Contract AC03-76SF00515. *Physical Review, The, C. Nuclear Physics ;* **23**: No. 1, 363-374(Jan 1981).

A description, including relevant formulas and numerical estimates, is presented of a set of polarization transfer experiments that appear to offer a feasible way to separate the deuteron charge and quadrupole form factors and measure the neutron and proton electric form factors. The experiments require a 2 to 4-GeV, high-intensity, high-duty factor, longitudinally polarized electron beam, and require that the polarization of the recoiling hadron be measured in a second, analyzing, scattering. The relevant asymmetries are fairly large, and calculations show that they are sensitive to different models obtained from existing data. Attention is called to the fact that the proposed deuteron measurements will require new 10% measurements of vector and tensor analyzing power of deuterons with kinetic energy from 150 to 450 MeV. 10 figures.

6453 Particle Invariance Principles And Symmetries

11772 (DOE/ER/01545—288) CP nonconservation in dynamically broken gauge theories. Lane, K. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1981. Contract AC02-76ER01545. 33p. NTIS, PC A03/MF A01.

The recent proposal of Eichten, Lane, and Preskill for CP nonconservation in electroweak gauge theories with dynamical symmetry breaking is reviewed. Through the alignment of the vacuum with the explicit chiral symmetry breaking Hamiltonian, these theories provide a natural way to understand the dynamical origin of CP nonconservation. Special attention is paid to the problem of strong CP violation. Even through all vacuum angles are zero, this problem is not automatically avoided. In the absence of strong CP violation, the neutron electric dipole moment is expected to be 10^{-24}-10^{-26} e-cm. A new class of models is proposed in which

both strong CP violation and large /ΔS/ = 2 effects may be avoided. In these models, /ΔC/ = 2 processes such as D/sup o/ D/sup - o/ mixing may be large enough to observe.

6454 Field Theory

11773 (BNL—28810) Bianchi-Baecklund transformations, conservation laws, and linearization of various field theories. Chau Wang, L.L. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 30p. NTIS, PC A03/MF A01.

The discussion includes: the Sine-Gordon equation, parametric Bianchi-Baecklund transformations and the derivation of local conservation laws; chiral fields, parametric Bianchi-Baecklund transformations, local and non-local conservation laws, and linearization; super chiral fields, a parallel development similar to the chiral field; and self-dual Yang-Mills fields in 4-dimensional Euclidean space; loop-cpace chiral equations, parallel development but with subtlety. (GHT)

11774 (BNL—28876) W's and Z's. Trueman, T.L. (Brookhaven National Lab., Upton, NY (USA)). Dec 1980. Contract AC02-76CH00016. 24p. (CONF-801244—1). NTIS, PC A02/MF A01.

From Workshop on weak interactions as probes of unification; Blacksburg, VA, USA (3 Dec 1980).

Ways of experimentally testing the intermediate vector boson masses calculated from the Glashow-Weinberg-Salam model in Su(5) are discussed. 12 figures, 22 refs. (GHT)

11775 (DOE/ER/01545—287) Vacuum periodicity in the instanton angle, chiral perturbation theory, and fractional topological charge. Palmer, W.F.; Pinsky, S.S. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1981. Contract AC02-76ER01545. 13p. NTIS, PC A02/MF A01.

Following Crewther, the methods of chiral perturbation theory and Dashen's theorem are applied to the QCD quark mass matrix. Stable domains of θ-vacua are found. The period of the system with respect to the instanton angle is 2π. It is concluded that non-integer topological charge is not required by chiral cymmetry breaking. An argument to the contrary by the present authors and by Crewther is refuted.

11776 (DOE/ER/02220—T2) Basic research in theoretical high energy physics. Progress report. Adler, S.L. (Institute for Advanced Study, Princeton, NJ (USA)). 1980. Contract ACS2-76ER02220. 14p. NTIS, PC A02/MF A01.

Research in theoretical quantum chromodynamics at Cornell University during 1979 is summarized. (GHT)

11777 Local gauge-invariant formulation of quantum electrodynamics. Sharp, D.H. (Los Alamos Scientific Lab., NM). pp 183-194 of Foundations of radiation theory and quantum electrodyamics. Barut, A.O. (ed.). New York, NY; Plenum Publishing Corporation (1980).

The manifest gauge invariance of this formulation is achieved by use of the electromagnetic field strengths, rather than potentials, to describe the electromagnetic field and local currents, rather than canonical fields, to describe the matter. To represent the theory in Hilbert space, the continuous unitary representations of the group obtained from the exponentiated currents and electromagnetic field strengths are studied. Although the formalism can be extended to include models with magnetic monopoles or several species of charged particles, the discussion is restricted to the case of a single species of particle with an electric charge. The algebra of the operators rho(x), J(x), P(x), E(x), and B(x) is explained, and representation theory is discussed. Questions raised by this work are examined. (RWR)

6455 Scattering Theory

11778 (DOE/ER/70004—284) Polarization as an instrument to explore the phenomenology and dynamics of vector spaces. Goldstein, G.R.; Moravesik, M.J. (Tufts Univ., Medford, MA (USA). Dept. of Physics; Oregon Univ., Eugene (USA). Dept. of Physics). 1980. Contract AT06-76ER70004. 15p. NTIS, PC A02/MF A01.

It is shown on the example of an extensive set of polarization data of p-p elastic scattering at 6 GeV/c and t = -0.6 GeV^2/c^2 that the careful choice of polarization formalisms to simplify the relationship between observables and amplitudes that nevertheless maintains a maximal amount of flexibility can enormously simplify the determination of the amplitudes as well as can yield clues to the dynamics underlying a reaction in atomic, nuclear, or high energy physics. 2 figures, 2 tables.

11779 (DOE/ER/70007—285) Symmetry laws and the limits to the power of polarization experiments. Moravesik, M.J. (Oregon Univ., Eugene (USA). Dept. of Physics). 1980. Contract AT06-76ER70004. 8p. NTIS, PC A02/MF A01.

It is shown that, in any reaction in particle, nuclear, atomic, or molecular physics containing an arbitrary number of particles of arbitrary spins, a determination, without a continuum of ambiguities, of a partial set of amplitude parameters from a partial set of polarization experiments is possible only either by utilizing measurements in which the polarization of all particles is fixed, or by using observables in which one or several particles are unpolarized, but this second option is open only for reactions in which parity is conserved and which contain no more than four particles. The implications of this theorem for the search of high-energy and nuclear dynamics are discussed.

65 PHYSICS RESEARCH

6510 Nuclear Physics

11780 Highly excited states in nuclear reactions. Ikegami, H.; Muraoka, M. (eds.). Suita Osaka, Japan; Research Center for Nuclear Physics, Osaka University (1980). 746p. (CONF-800540—). NTIS (US Sales Only), PC A99/MF A01.

From International symposium on highly excited states in nuclear reactions; Osaka, Japan (12 May 1980).

Three of the 62 papers in this volume have already been processed for inclusion in the energy data base; these may be found by reference to the entry CONF-800540— in the Report Number Index. The remaining papers will be entered into the data base as they are received from INIS. (RWR)

6512 Nuclear Properties And Reactions, A=1-5

REFER ALSO TO CITATION(S) 11757, 11771

11781 (LA—8401-MS) Kinematically incomplete breakup reaction ^{1}H(vector d,p)pn at 16 MeV. Ohlsen, G.G.; Correll, F.D.; Brown, R.E.; Jarmie, N.; Hardekopf, R.A. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 15p. NTIS, PC A02/MF A01.

Angular distributions of the differential cross section σ(E*,theta$_1$/sup l/) and of the vector and tensor analyzing powers A/sub y/(E*,theta$_1$/sup l/), A/sub xz/(E*,theta$_1$/sup l/), A/sub xx/(E*,theta$_1$/sup l/), A/sub yy/(E*,theta$_1$/sup l/) for the 3-nucleon breakup reaction ^{1}H(vector d,p)pn were measured for a deuteron bombarding energy of 16.0 MeV. The data are reported as functions of the excitation energy E* in the pn system and of the laboratory angle theta$_1$/sup l/. Laboratory angles between 15 and 42.5^0 were studied. The excitation energy range varies from 0 to 2.6 MeV at 15^0 to 0 to 0.2 MeV at 42.5^0. An excitation energy range (bin) of 0.2 MeV, which corresponds to laboratory energy bins from 0.3 to 0.4 MeV, was used to partition the proton continua. The experimental laboratory energy resolution is about 0.15 MeV. Large effects are seen in the tensor analyzing powers, particularly in A/sub xz/, at the lowest excitation energies. Except for A/sub yy/, there is no similarity of the observed analyzing powers to the

corresponding elastic-scattering analyzing powers. Some data for A/sub xz/(E*,theta$_1$/sup l/) at other energies are also presented. 11 figures, 6 tables.

6513 Nuclear Properties And Reactions, A=6-19

11782 **(AD—463439) Electron scattering from nuclear magnetic moments.** Griffy, T.A.; Yu, D.U.L. (Stanford Univ., CA (USA). High-Energy Physics Lab.). Mar 1965. 26p. NTIS PC03/MF A01.

The elastic scattering of high-energy electrons from the magnetic dipole and magnetic octupole moments of light nuclei is calculated using shell model wave functions. The results of the calculation are compared with recent experimental results for ^{9}Be and ^{11}Be and the possibility of obtaining a value for the magnetic octupole moment from an analysis of these experiments is discussed.

11783 **Variations in fusion cross sections for different light heavy-ion systems.** Vandenbosch, R. (Univ. of Washington, Seattle). *Nuclear Physics,* [*Section*] *A ;* **339**: 167-174(1980).

Fusion cross sections are calculated with a classical trajectory model incorporating the nuclear proximity potential and one-body proximity friction with radius and diffuseness parameters for each system taken from electron scattering results. Qualitative agreement with experiment is achieved, although significant discrepancies exist for several systems. Comparisons with recent TDHF calculations are also made. 6 figures, 1 table.

6515 Nuclear Properties And Reactions, A=39-58

11784 **(LA—8626-MS) Evaluated neutron-induced cross sections for $^{54\ 56}$Fe to 40 MeV.** Arthur, E.D.; Young, P.G. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 105p. (ENDF—304). NTIS, PC A06/MF A01.

Cross sections for neutron-induced reactions on $^{54\ 56}$Fe were calculated employing several nuclear models - optical, Hauser-Feshbach, preequilibrium, and DWBA - in the energy range between 3 and 40 MeV. As a prelude to the calculations, the necessary input parameters were determined or verified through analysis of a large body of experimental data for both neutron- and proton-induced reactions in this mass and energy region. Calculated cross sections as well as neutron and gamma-ray emission spectra were incorporated into an ENDF/B-formatted evaluation suitable for use to 40 MeV. Details of both the calculations and the final evaluated data files are described in this report, and extensive comparisons to experimental data are given. 169 references, 66 figures, 9 tables.

11785 **Study of the ^{45}Sc(n,γ) reaction.** Liou, H.I.; Chrien, R.E. (Brookhaven National Lab., Upton, NY (USA)); Kopecky, J.; Konter, J.A. (Stichting Reactor Centrum Nederland, Petten). *Nuclear Physics,* [*Section*] *A ;* **337**: No. 3, 401-430(Mar 1980).

Primary and secondary γ-rays from the ^{45}Sc(n,γ) reaction were measured at four resonances, two of them of p-wave (460.6 and 1060.4 eV) and the others of s-wave (3290 and 4330 eV) character. High-accuracy measurements at near the thermal region (0.14-7.65 eV) resulted in an improved set of primary γ-ray energies and level energies above 1 MeV. We obtain a neutron binding energy B/sub n/(^{45}Sc) = 8760.5(2) keV. Absolute intensities of primary capture γ-rays were derived by comparison to the resonance capture in gold at 4.91 eV. E1 and M1 radiation strengths were observed to be about equal. No correlation of any kind [either between (n,γ) or (d,p) strengths or between adjacent s- and p-wave capture] was observed. The primary γ-ray spectrum following the capture of polarized neutrons in oriented and unoriented ^{45}Sc nuclei was studied. A combined chi^2 analysis of these two experiments resulted in 21 unique spin assignments and many spin restrictions. The fraction of spin J = 3$^-$ in thermal capture was determined to be (92 +- 5)%. From the observed transition rates to final states of known spin, J = 3 assignments result for the two p-wave resonances studied.

11786 **Quantum beats of recoil-free γ-radiation.** Perlow, G.J.; Monahan, J.E. (Argonne National Lab., IL (USA)); Potzel, W. (Technische Universitaet Muenchen, Garching (Germany F.R.)). *Journal de Physique (Paris), Colloque ;* 85-93(1980).

From International conference on Moessbauer spectroscopy; Portoroz, Yugoslavia (10 - 14 Sep 1979).

The radiation from a Moessbauer source of ^{57}Co in a copper matrix is frequency-modulated by vibrating the source with a quartz piezo-crystal driven by an oscillator. If the radiation passes through a resonant absorber (a 'filter'), a time structure containing the oscillator frequency and its harmonics appears in the resulting counting rate. It may be seen by sorting the time of each count with respect to the cross-over time of a subharmonic of the oscillator. These quantum beats are caused by interferences between the frequency components of the photon amplitude, and vanish unless there is some alteration of relative phase or amplitude of the original radiation by the filter. The harmonic constitution of the beats is a sensitive function of the relative shift of source and filter and may be used as a sensitive probe of small shifts. This is demonstrated by measuring the temperature shift in ^{57}Fe-Be. If a velocity spectrum is made with counts collected during only a part of the vibration cycle, prominent dispersion effects are seen, with counting rates higher than background in some portions of the spectrum. A classical optical theory of the phenomenon is presented in summary. It explains the beats, the dispersion effects, and the sensitivity of the harmonic ratios to relative shifts.

6517 Nuclear Properties And Reactions, A=90-149

REFER ALSO TO CITATION(S) 11792

11787 **Survey of radiative dipole strength functions.** McCullagh, C.M. Stony Brook, NY; State Univ. of New York (1979). 233p. University Microfilms Order No. 79-18,047.

Thesis (Ph. D.).

Neutron capture gamma-ray spectroscopy has been used to investigate the systematic behavior of radiative transitions from the capture state. Thirteen measurements following thermal, resonance-averaged and discrete-resonance capture have been performed. The thermal and resonance-averaged results provided many of the final-state spins and parities needed to determine the multipolarity of the radiative transitions. The results were combined with previous measurements to form a survey of electric and magnetic dipole absolute partial widths in approximately fifty nuclides. Two theoretical models were tested: the single-particle model and the collective model (giant resonances). The electric dipole data for masses greater than sixty were best described by using the Lorentzian approximation to the tail of the giant dipole resonance. Evidence for direct capture effects near mass equal ninety and the possibility of structure on the tail of the giant resonance not described by the Lorentzian approximation in heavy nuclides was seen. The magnetic dipole strength behavior was shown not to follow the single-particle predictions, but to agree qualitatively with the predictions resulting from a giant magnetic dipole resonance located near the neutron separation energy. The magnetic dipole strengths were observed to be generally enhanced over the single-particle estimates. In conclusion, the collective model through giant resonances described the electric and magnetic dipole transition systematics better than the single-particle model.

6519 Nuclear Properties And Reactions, A=190-219

11788 **(LA-UR—81-206) Competition from the ν/sub e/ ^{208}Pb → ^{208}Bi e$^-$ reaction in a search for ν/sub μ/-bar → ν/sub e/-bar oscillation.** Toevs, J.W.; Kruse, H.W. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 7p. (CONF-810115—2). NTIS, PC A02/MF A01.

From Nuclear and particle physics at energies up to 31 GeV: new and future aspects conference; Los Alamos, NM, USA (Jan 1981).

Inverse beta-decay reactions produced by electron neutrinos may compete with muon neutrino reactions in experiments utilizing

the neutrino flux from a beam stop. The cross section and angular distribution for one such reaction, ν/sub e/ $^{208}Pb \rightarrow {}^{208}Bi\ e^-$, have been calculated with the aid of the results of an investigation of ^{208}Pb (p,n)^{208}Bi at low momentum transfer. The implications of this reaction on an experiment to study neutrino oscillation are discussed. 2 figures.

11789 Microscopic description of normal parity excitations in the $^{208}Pb(p,p')$ reaction at 135 MeV and the shape of the nucleon-nucleon interaction. Petrovich, F. (Florida State Univ., Tallahassee (USA). Dept. of Physics); Love, W.G. (Georgia Univ., Athens (USA). Dept. of Physics and Astronomy); Adams, G.S.; Bacher, A.D.; Emery, G.T.; Jones, W.P.; Miller, D.W. (Indiana Univ., Bloomington (USA). Cyclotron Facility). *Physics Letters, [Section] B ;* **91**: No. 1, 27-31(Mar 1980).

A microscopic study of new 135 MeV inelastic proton scattering data for the excitation of normal parity levels in ^{208}Pb with spins covering the range J = 2 to 10 is reported. The short range repulsion in the central nucleon-nucleon interaction results in small central contributions to the cross sections for the transitions with J = 8 and 10.

11790 Inelastic excitation of normal parity levels in ^{208}Pb by 135 MeV protons. Adams, G.S.; Bacher, A.D.; Emery, G.T.; Jones, W.P.; Miller, D.W. (Indiana Univ., Bloomington (USA). Cyclotron Facility); Love, W.G. (Georgia Univ., Athens (USA). Dept. of Physics and Astronomy); Petrovich, F. (Florida State Univ., Tallahassee (USA). Dept. of Physics). *Physics Letters, [Section] B ;* **91**: No. 1, 23-26(Mar 1980).

New cross section data for the inelastic excitation of normal parity levels in ^{208}Pb with spins ranging from J = 2 to J = 12 are reported. The data are examined in terms of the collective model including deformed spin-orbit coupling. The experimental differential cross sections exhibit a striking transition from central dominated shapes to spin-orbit dominated shapes at J = 8.

6520 Nuclear Properties And Reactions, A=220 And Above

11791 (DOE/ER/10452—1) High-resolution photofission measurements in ^{238}U and ^{232}Th. Progress report, June 1, 1979-February 10, 1980. Lancman, H. (Brooklyn Coll., NY (USA)). Feb 1980. Contract AS02-79ER10452. 21p. NTIS, PC A02/MF A01.

High-intensity proton beams have been used to generate gamma rays of well-defined and variable energy from the (p,γ) reaction on a number of targets. Spectra of photofission fragments of ^{238}U and ^{232}Th have been measured at gamma ray energies from 5.8 to 11.5 MeV. The photofission cross sections have been determined and preliminary values of barrier parameters, derived by fitting the data to model predictions.

11792 (EPRI-NP—1658) Integral tests of fast neutron dosimetry cross sections. Final report. Johnson, R.H. (Purdue Univ., Lafayette, IN (USA). School of Nuclear Engineering). Jan 1981. Contract AS02-76ET37237. 77p. NTIS, PC A05/MF A01.

Integral tests of a variety of dosimetry cross sections have been performed using the Fast Breeder Blanket Facility (FBBF). A number of dosimetry reaction rates (both fission and activation) were measured at selected positions within the FBBF. The reactions studied were chosen from the set of dosimetry reactions being used in EPRI's pressure vessel surveillance program. Neutron spectra were measured at the same positions using proton recoil spectrometry; calculated spectra were also available for those positions. Composite neutron spectra, based on measurements as well as calculations, were used with the ENDF/B-IV dosimetry file to calculate the dosimetry reactions rates. These calculated reaction rates have been compared with measured reaction rates. Several recommendations on the adequacy of dosimetry cross sections have been based on the results of these integral tests.

11793 (LA-UR—81-301) Dissipation and diffusion in nuclear fission. Nix, J.R.; Sierk, A.J. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 8p. (CONF-810119—1). NTIS, PC A02/MF A01.

From 19. international winter meeting on nuclear physics; Bormio, Italy (Jan 1981).

The dynamical descent of nuclei from the fission saddle point onwards was calculated for two extreme dissipation mechanisms: wall-and-window one-body dissipation and ordinary two-body viscosity. This calculation was done by solving numerically the classical generalized Hamilton equations of motion for a fissioning nucleus, with the nuclear potential energy of deformation calculated in terms of a Coulomb energy and a double volume integral of a Yukawa-plus-exponential folding function, the collective kinetic energy calculated by means of the Werner-Wheeler approximation to incompressible irrotational flow. The most probable dynamical trajectories calculated for the two types of dissipation are shown for the fission of ^{236}U. Although one-body dissipation leads to compact scission shapes and two-body viscosity leads to elongated scission shapes, both types of dissipation reproduce equally well experimental most probable fission-fragment kinetic energies for the fission of nuclei throughout the periodic table. The relative insensitivity of the final kinetic energies to the dissipation mechanism arises because the reduced postscission kinetic energy resulting from an elongated scission shape with two-body viscosity is compensated by a larger prescission kinetic energy. 3 figures. (RWR)

11794 New spontaneous fission activities produced in the bombardments of ^{248}Cm and ^{249}Bk by ^{13}C, ^{15}N, ^{16}O, and ^{18}O ions. Somerville, L.P. (Univ. of California, Berkeley). pp 337-338 of Future directions in studies of nuclei far from stability. Hamilton, J.H. (ed.). Amsterdam, Netherlands; North-Holland Publishing Company (1980).

With the aid of an ~ 970-meter-long .025-mm-thick nickel tape to transport recoils in front of fixed mica track detectors, several new spontaneous fission activities were observed in bombardments at the 88-inch cyclotron. In the bombardments 92-MeV ^{16}O + ^{248}Cm and 82-MeV ^{15}N + ^{249}Bk using ~ 0.5 mg/cm^2 targets, the previously reported 19 ms SF activity was observed again with production cross sections of 3 to 5 nb and 6 to 9 nb, respectively. No evidence was found for the 80-ms SF activity reported by the Dubna group, the present upper limits for the production cross section of this activity being 0.2 nb in 92-MeV ^{16}O + ^{248}Cm and 0.0 to 0.2 nb for 82-MeV ^{15}N + ^{249}Bk bombardments. Excitation functions were measured for the short-lived SF activities produced in the reaction ^{18}O + ^{248}Cm. A new spontaneous fission activity with a half-life of 54 ms and a narrow excitation function peaking near 90 MeV. In a 70-MeV ^{13}C + ^{249}Bk bombardment an SF activity with a half-life 4.8 +- 0.7 sec and a production cross section of 2 to 4 nb were observed. A possible assignment for this activity is a 0.2 to 0.4% electron capture branching of ^{258}Lr to the known 1.2 ms SF activity ^{258}No.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 11768, 11778, 11779

11795 (DOE/ER/10397—2) Theory of electron induced reactions. Progress report, May 1, 1980-April 30, 1981. Onley, D.S.; Wright, L.E. (Ohio Univ., Athens (USA)). Feb 1981. Contract AC02-79ER10397. 23p. NTIS, PC A02/MF A01.

(I) The problem of finite-size effects in virtual photon spectra was studied from several directions. It was found that a model-independent correction to the spectrum could be defined for energies up to 200 MeV. It is shown, however, that drastically different current distributions for an M1 transition all share the same transition radius and produce the same correction to the M1 virtual spectrum. This insensitivity to details of the transition is evidently due to a predominance of low-momentum-transfer components, which selects only comparatively low moments of the corresponding form factors. Simultaneous correction for finite size and Coulomb forces (finite charge) was studied, and an alarming interaction between the two corrections was found. (II) Coulomb distortion effects in pair production were also calculated. The distortion factor, which is the ratio of the total pair production cross section with Coulomb dis-

tortion to the plane-wave (Bethe-Heitler) result, is shown as a function of photon energy for Z = 92. (III) Some work was also done on pion electroproduction. The model showed good agreement with available experimental data. 8 figures. (RWR)

11796 **Accuracy and convergence of a variational theory of nuclear matter for v_6 models.** Wiringa, R.B. (Los Alamos Scientific Lab., NM (USA)). *Nuclear Physics, [Section] A ;* **338**: No. 1, 57-76(Apr 1980).

A number of higher-order terms in a previously proposed variational theory of nuclear matter are examined to establish the accuracy and convergence of the method. Numerical results for four semirealistic v_6 model interaction, which include central, spin, isospin and tensor components, are reported. Although individual higher-order terms are substantial (> 1 MeV) they are much smaller than the corresponding lower-order terms, indicating good convergence of the theory. The higher-order terms also tend to cancel out, and three of the four v_6 models show little net change in their E(k/sub F/) curves, compared to previous work. The method is believed to have an error <= 1 MeV for k/sub F/ <= 1.6 fm^{-1}.

11797 **Correspondence between fermion and boson states and operators.** Ginocchio, J.N. (Los Alamos Scientific Lab., NM (USA). Theoretical Div.); Talmi, I. (Massachusetts Inst. of Tech., Cambridge (USA). Center for Theoretical Physics; Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science; Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics). *Nuclear Physics, [Section] A ;* **337**: No. 3, 431-444(Mar 1980).

Mapping of shell-model (fermion) Hamiltonians onto boson Hamiltonians which underly the interaction boson model is investigated. A simple correspondence is defined and a sufficient condition, given for shell-model Hamiltonians to correspond simply to finite hermitian boson Hamiltonians. A special case is discussed where diagonalization of a shell-model Hamiltonian for valence protons and neutrons can be exactly carried out in an equivalent (but different) boson space. If, however, the proton Hamiltonian and neutron Hamiltonian are diagonal in the seniority scheme, mapping of fermion states onto orthogonal boson states cannot be a simple correspondence. In that case the boson quadrupole operators equivalent to fermion quadrupole operators cannot be single-boson operators but must be more complicated ones.

6540 Radiation And Shielding Physics

11798 **(AD—415685) Inelastic scattering of neutrons by anharmonic crystals.** Ambegaokar, V.; Conway, J.M.; Baym, G. (Cornell Univ., Ithaca, NY (USA)). 1963. 31p. NTIS, PC A03/MF A01.

The purpose of this study was to determine the phonon frequencies and lifetimes from these experiments. When a crystal has anharmonicities interference effects can occur between processes in which the neutron creates several phonons; these coherences are due to the fact that when a phonon can decay into several phonons, the final state in which the neutron has created one phonon is not orthogonal to final states in which the neutron has created several phonons. It is shown that the Placzek sum rule is still a valid guide in subtracting the multiphonon background from the experimental cross-section. The remaining cross-section is the sum of the one-phonon cross-section and the "one-phonon, several-phonon" interference terms. The one phonon cross-section has a resonance at the phonon frequency, with a width proportional to the inverse of the phonon lifetimm0-however, the interference terms have the effect of shift ing the center of this resonance, as observed, from the one-phonon frequency, and also changing the shape from an expected Lorentizian form.

11799 **(AD-A—087107) Electronic stopping power calculations for all heavy ions at low velocity in all elements. Final report.** Brennan, J.G.; Land, D.J. (Naval Surface Weapons Center, Silver Spring, MD (USA)). 17 Mar 1980. 66p. NTIS, PC A04/MF A01.

Values of the electronic stopping power for projectiles from carbon to uranium in elemental targets from hydrogen through the transuranic elements at the Bohr velocity, are presented in sets of tables. The stopping powers were calculated within a modified Firsov model. An algorithm for determining the stopping power from v=0 to v=3 to 4 v sub o is discussed. The stopping powers, as obtained from this algorithm, are compared with an extensive collection of experimental data. The results are presented in a series of graphs.

11800 **(EGG-PHYS—5267) QAD-BSA point-kernel shielding code.** Young, T.E. (EG and G Idaho, Inc., Idaho Falls (USA)). Dec 1980. Contract AC07-76ID01570. 48p. NTIS, PC A03/MF A01.

QAD-BSA, a three-dimensional, point-kernel shielding code, calculates photon dose rates and heating rates by using exponential attenuation and infinite-medium buildup factors. Calculational provisions include estimates of fast-neutron penetration using the moments method. Included geometry routines can describe complicated source and shield geometries. An internal library contains data for many frequently used structural and shielding materials; hence, the code can solve most problems with only source strengths and problem geometry as input. This code adapts especially well to problems requiring multiple sources and sources with asymmetrical geometry. In addition to being edited separately, the total interaction rates from many sources may be edited at each detector point. Calculated photon interaction rates agree closely with those obtained using another point-kernel code (QAD-P5A) and an S/sub n/ transport code (SCAMP). 2 figures, 1 table.

11801 **(LA-UR—81-100) Nodal methods for discrete-ordinates transport problems in (x,y) geometry.** Walters, W.F.; O'Dell, R.D. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 14p. (CONF-810415—1). NTIS, PC A02/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

A nodal method has been developed for improved spatial differencing of the discrete-ordinates form of the x,y geometry transport equation. In applying this method, spatial flux expansions are assumed along the edges of each solution node (mesh cell), and flux and source expansions are assumed in the interior of the node. Nodal method schemes are thus identified by the expansions used for node edges and node interior. Nodal schemes assuming constant-constant, constant-linear, and four forms of linear-linear expansion have been developed, programed, and used in the analysis of eigenvalue (k/sub eff/) and shielding problems. Nodal results are compared with those obtained by means of the diamond-difference scheme. On the basis of results of eigenvalue test problems examined by the authors, it appears that the linear-linear nodal method schemes are more cost effective than the diamond-difference scheme for eigenvalue (k/sub eff/) problems. These nodal schemes, although more computationally costly than the diamond scheme per mesh cell, yield results of comparable accuracy to those from diamond with far fewer mesh cells. A net savings in both computer time and storage is obtained with the nodal schemes when compared with the diamond scheme for the same accuracy of results. For shielding problems both the constant-linear and linear-linear nodal schemes are superior to the diamond scheme in the sense of reduced computer time and storage for the same accuracy in results. 2 figures, 2 tables.

11802 **(LA-UR—81-101) Linear characteristic method for spatially discretizing the discrete ordinates equations in (X,Y)-geometry.** Larsen, E.W.; Alcouffe, R.E. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 15p. (CONF-810415—3). NTIS, PC A02/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

A new linear characteristic (LC) spatial differencing scheme for the discrete-ordinates equations in (x,y) geometry is described, and numerical comparisons are given with the diamond difference (DD) method. The LC method is more stable with mesh size and is generally much more accurate than the DD method on both fine and coarse meshes, for eigenvalue and deep-penetration problems. The LC method is based on computations involving the exact solution of a cell problem that has spatially linear boundary conditions and interior source. The LC method is coupled to the diffusion syn-

thetic acceleration (DSA) algorithm in that the linear variations of the source are determined in part by the results of the DSA calculation from the previous inner iteration. An inexpensive negative-flux fixup is used which has very little effect on the accuracy of the solution. The storage requirements for LC are essentially the same as that for DD, while the computational times for LC are generally less than twice the DD computational times for the same mesh. This increase in computational cost is offset if one computes LC solutions on somewhat coarser meshes than DD; the resulting LC solutions are still generally much more accurate than the DD solutions. 4 figures, 6 tables.

11803 **(ORNL/TM—7631) Method for sampling from fission neutron energy spectra.** Froehner, F.H.; Spencer, R.R. (Oak Ridge National Lab., TN (USA)). Feb 1981. Contract W-7405-ENG-26. 13p. NTIS, PC A02/MF A01.

A simple method for fast and efficient sampling from the Watt fission neutron energy spectrum is described. As a limiting case the Maxwellian energy distribution can also be sampled. A short FORTRAN routine written for this purpose and results obtained with it are presented. The routine is shown to give accurate results, and requires <1 ms/sample on a DEC KA-10 processor. 1 figure, 1 table.

6550 Medical Physics

11804 **(DOE/EV—0045(Rev.2.81)) Study of anticipated impact on DOE programs from proposed reductions to the external occupational radiation exposure limit.** (Department of Energy, Washington, DC (USA). Div. of Operational and Environmental Safety). Feb 1981. 27p. NTIS, PC A03/MF A01.

A study of the impact of reducing the occupational radiation exposure limit from 5 rem/yr to 2.5, 1.0 and 0.5 rem/yr, respectively produced the following conclusions: reduction of the occupational exposure limit would result in significant increase in total accumulated exposure to the current radiation worker population and could require an increase in the work force; important programs would have to be abandoned at a planned exposure limit of 0.5 rem/yr; some engineering technology is not sufficiently developed to design or operate at the 0.5 rem/yr limit; even a factor of 2 reduction (2.5 rem/yr) would significantly increase costs and would result in an increase in total exposure to the work force; in addition to a significant one-time initial capital cost resulting from a 0.5 rem/yr limit, there would be a significant increase in annual costs; the major emphasis in controlling occupational exposure should be on further reduction of total man-rem; and current standards are used only as a limit. For example, 97% of the employees receive less than 0.5 rem/yr.

11805 **(DOE/EV/03522—T1) Biological and clinical dosimetry. Progress report, October 1, 1979-September 30, 1980.** Laughlin, J.S.; McDonald, J.C. (Sloan-Kettering Inst. for Cancer Research, New York (USA). Radiation Biophysics Lab.). 30 Sep 1980. Contract AS02-76EV03522. 26p. NTIS, PC A03/MF A01.

Several major dosimetric intercomparisons were carried out during the last year. At the National Institute of Radiological Sciences, Chiba-shi and the University of Tokyo, Tokyo, Japan, calorimetric and ionimetric intercomparisons of dose were performed. Similar measurements were also carried out at the Lawrence Berkeley Laboratory, Los Alamos, and Harvard. The measurements of the thermal defect for A-150 plastic were completed and an average value of (4.1 +- 0.3)% was found. Preliminary measurements using a cryogenic calorimeter were carried out at Lawrence Livermore National Laboratory. The first measurement of the event size distribution for 20-MeV neutrons were carried out at Ohio University and an interesting difference between the measurement and theoretical calculations was found. The measured fraction of events due to alpha particles was found to be significantly lower than the fraction predicted by the calculation of Caswell and Coyne.

11806 **(ORNL/TM—7615) Sixth personnel dosimetry intercomparison study.** Swaja, R.E.; Greene, R.T.; Dickson, H.W. (Oak Ridge National Lab., TN (USA)). Feb 1981. Contract W-7405-ENG-26. 67p. NTIS, PC A04/MF A01.

The Sixth Personnel Dosimetry Intercomparison Study was conducted March 25 to 27, 1980, at the Oak Ridge National Laboratory. Dosimeters from 28 participating agencies were mounted on anthropomorphic phantoms and exposed to a range of low-level dose equivalents (1.8 to 11.5 mSv neutron, 0.1 to 1.1 mSv gamma) which could be encountered during routine personnel monitoring in mixed radiation fields. The Health Physics Research Reactor (HPRR) operated in the steady-state mode served as the source of radiation for six separate exposures. Lucite and concrete shields along with the unshielded reactor were used to provide three different neutron and gamma spectra. Results reported by the participating agencies showed that TLD-albedo and TLD-700 dosimeters generally provided the most accurate measurements of neutron and gamma dose equivalents, respectively. Film was found to be unsatisfactory for measuring neutron doses produced by HPRR spectra in that measured dose equivalents were much lower than reference values. The TLD-100 dosimeters yielded gamma doses which were much too high indicating that this dosimeter type is generally unsuitable for use in mixed radiation fields similar to those encountered in this study without the use of large correction factors. Although the overall reported results exhibited improvement in performance relative to previous intercomparison studies, the composite measured data showed variations of more than a factor of 2 between measurements of the same exposure made by different agencies.

11807 **(ORNL/TM—7621) Report of the Task Group Calculations to ICRP Committee 2, October 14-17, 1980.** Ford, M.R. (Oak Ridge National Lab., TN (USA)). Feb 1981. Contract W-7405-ENG-26. 22p. NTIS, PC A02/MF A01.

This is the third in the series of reports of the Task Group on Dose Calculations to the International Commission on Radiological Protection (ICRP) Committee 2 as constituted for the four-year period 1977-1981. The two previous reports are documented in ORBL/TM-6988 (April 1979) and ORNL/TM-7230 (March 1980), respectively. Since the last meeting of the Committee, the Task Group has completed the computation of annual limit on intake (ALI) and derived air concentration (DAC) values and the corresponding supplemental data for 37 of the 43 elements planned for inclusion in the third and last part of the Committee report. The report entitled Limits for Intakes of Radionuclides by Workers, ICRP Publication 30 is being issued in three parts; and for each part, a supplement will be issued containing photocopied, computer-formatted supplemental data tables. Part 1 and the Supplement to Part 1 were both published in 1979, and the material for Part 2 and the Supplement to Part 2 are at Pergamon Press. Part 3 and Supplement will be ready for publication in 1981. The Task group plans to issue a separate report on radionuclide transformations used in estimating the ALI and DAC values in Publication 30. Preliminary data are being generated for this report, which will be timed to appear soon after the publication of Part 3 and the Supplement to Part 3.

11808 **Comparison of static and dynamic treatment modes for the pion therapy beam at LAMPF.** Hogstrom, K.R. (Univ. of Texas Cancer System, Houston); Paciotti, M.A.; Smith, A.R.; Collier, M. *International Journal of Radiation Oncology, Biology and Physics ;* 6: No. 12, 1693-1700(Dec 1980).

Focused beams of negative pions have been developed for dynamic treatments at the Biomedical Facility in Los Alamos. In dynamic treatment, the patient is scanned under a focused pion beam. Using measured depth-dose distributions and off-axis dose distributions, we are able to find a scanning function that allows the best coverage of the target volume. Calculation of dose distributions for dynamic beam treatment plans, both in a water phantom and in a patient, illustrates the superiority of dynamic over static treatments that use broad, essentially parallel beams in shaping the dose distribution to the target volume.

6560 Solid State Physics

REFER ALSO TO CITATION(S) 11741

11809 (BNL—28795) Defect characterization with positron annihilation. Granatelli, L.; Lynn, K.G. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 30p. (CONF-8010157—1). NTIS, PC A03/MF A01.

From Symposium on nondestructive evaluation; Pittsburgh, PA, USA (20 Oct 1980).

Positron annihilation in metal crystals is reviewed. A brief introduction to the positron annihilation technique is presented first. Then the ability of the positron technique to perform microstructural characterization of four types of lattice defects (vacancies, voids, dislocations, grain boundaries) is discussed. It is frequently not possible to obtain samples that contain only one type of defect in nonnegligible concentrations. Such situations exist for some alloys and for fatigued metal samples. Finally, the current limitations and some future prospects of the technique are presented. 79 references, 14 figures, 1 table. (RWR)

11810 (LA—8674-MS) Brillouin-zone integration schemes: an efficiency study for the phonon frequency moments of the harmonic, solid, one-component plasma. Albers, R.C.; Gubernatis, J.E. (Los Alamos Scientific Lab., NM (USA)). Jan 1981. Contract W-7405-ENG-36. 25p. NTIS, PC A02/MF A01.

The efficiency of four different Brillouin-zone integration schemes including the uniform mesh, special point method, special directions method, and Holas method are compared for calculating moments of the harmonic phonon frequencies of the solid one-component plasma. Very accurate values for the moments are also presented. The Holas method for which weights and integration points can easily be generated has roughly the same efficiency as the special directions method, which is much superior to the uniform mesh and special point methods for this problem.

11811 (LA-UR—80-3528) Amplified reflection via degenerate four-wave mixing in a laser induced free carrier plasma in germanium. Watkins, D.E.; Phipps, C.R. Jr.; Thomas, S.J. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810312—1). NTIS, PC A02/MF A01.

From International conference on excited states and multiresonance nonlinear optical process in solids; Modane, France (18 Mar 1981).

The first observation of amplified reflection at CO_2 laser wavelengths via degenerate four-wave mixing in an optically induced free-carrier plasma in germanium is presented. Reflectivities of over 100% are reported in both n-type and p-type Ge. A model is presented which predicts both the magnitude and the I^{11} intensity dependence of the reflectivity from the free carrier plasma density. This density is determined experimentally by time-resolving the incident and transmitted signals obtained above the plasma formation threshold and deducing the free carrier density via a detailed model which relates this quantity to the instantaneous, intensity-dependent transmission.

11812 Aspects of the kinetics and dynamics of surface reactions. Landman, U. (ed.). New York, NY; American Institute of Physics (1980). 346p. (CONF-7908108—).

From Conference on surface physics; LaJolla, CA, USA (6 Aug 1979).

One of the papers in this volume has already been cited in ERA; it may be located by reference to the entry CONF-7908108—1 in the Report Number Index. The remaining papers in scope for the TIC data base will be included as they are received from AIP. (RWR)

6570 Theoretical Physics

11813 (LA—8370-MS) Dynamic Theory: a new view of space, time, and matter. Williams, P.E. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 177p. NTIS, PC A09/MF A01.

The theory presented represents a different approach toward unification of the various branches of physics. The foundation of the theory rests upon generalizations of the classical laws of thermodynamics, particularly Caratheodory's abstract statement of the second law. These adopted laws are shown to produce, as special cases, current theories such as Einstein's General and Special Relativity, Maxwell's electromagnetism, classical thermodynamics, and quantum principles. In addition to this unification, the theory provides predictions that may be experimentally investigated. Some of the predictions are a limiting rate of mass conversion, reduced pressures in electromagnetically contained plasmas, increased viscous effects in shocked materials, a finite self-energy for a charged particle, and the possible creation of particles with velocities greater than the speed of light. 8 figures.

11814 (LA—8402-MS) Dynamic Theory: some shock wave and energy implications. Williams, P.E. (Los Alamos Scientific Lab., NM (USA)). Feb 1981. Contract W-7405-ENG-36. 11p. NTIS, PC A02/MF A01.

The Dynamic Theory, a unifying five-dimensional theory of space, time, and matter, is examined. The theory predicts an observed discrepancy between shock wave viscosity measurements at low and high pressures in aluminum, a limiting mass-to-energy conversion rate consistent with the available data, and reduced pressures in electromagneticaly contained controlled-fusion plasmas.

11815 Coherent states for the isotonic oscillator. Gutschick, V.P. (Los Alamos Scientific Lab., NM); Nieto, M.M.; Simmons, L.M. Jr. *Physics Letters,* [*Section*] *A ;* **76**: No. 1, 15-18(3 Mar 1980).

Gaussians are not, as a matter of principle, allowable wave function for the isotonic oscillator system. Appropriate coherent states for nonharmonic potentials are minimum-uncertainty coherent states. Moreover, they provide a better approximation to the classical motion than do gaussians. 2 figures, 1 table.

6590 Communication, Education, History, And Philosophy

REFER ALSO TO CITATION(S) 11813

70 FUSION ENERGY

REFER ALSO TO CITATION(S) 10920

7001 Plasma Research

REFER ALSO TO CITATION(S) 11839

11816 (COO—2218-189) Stable heating and burn simulations of a reversed-field pinch reactor. Moses, R.W.Jr.; Nebel, R.A.; Miley, G.H. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract AS02-76ET52040. 7p. (CONF-800932—7). NTIS, PC A02/MF A01.

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

The reversed-field pinch provides three significant advantages as a fusion reactor: it can be ohmically heated, it operates at high β, and it is not restricted to a small aspect ratio. Experimentally, the best understood startup scenarios are self reversal, aided reversal and fast-field programming. On the basis of results from a one-dimensional transport and stability code, an ideal MHD stable startup and burn procedure is described in this paper. Pitch programming and a gas feed at the wall are used. This adiabatic startup is characterized by a high pitch near the minor axis and hollow current and pressure profiles. Ideally, it would be possible to have a reactor startup and burn without highly turbulent processes to deposit excessive amounts of energy on the wall Potential problems of resistive instabilities and plasma-wall interactions are discussed.

11817 (DOE/ER/53091—T1) Electron capture and loss cross sections and angular scattering of $D^{+\ 0\ -}$ in Cs: formation of D^- beams for MFE experiments and reactors. Technical progress report No. 1, January 2-November 30, 1980. Coggiola, M.J.; Peterson, J.R. (SRI International, Menlo Park, CA (USA)). 13 Jan 1981. Contract AT03-80ER53091. 16p. NTIS, PC A02/MF A01.

This project is a combined experimental and modeling effort directed to problems in negative ion beam formation that are important in the design and development of high energy neutral injectors for the DOE fusion program. Specifically, the present program is concerned with the electron capture and loss mechanisms and the associated angular scattering effects that govern the production of D^- via double charge-transfer of D^+ in alkali vapors at energies below 1 keV/amu. The overall aim of this project is to provide guidance in the selection of an optimal D^- production scheme, both with regard to the choice of target material as well as collision energy.

11818 (DOE/ET/53051—15) High power ICRH experiments on the Wisconsin levitated octupole. Strait, E.J.; Fortgang, C.M.; Twichell, J.C.; Dexter, R.N.; Sprott, J.C.; Barter, J.D. (Wisconsin Univ., Madison (USA); TRW Systems, Redondo Beach, CA (USA)). Dec 1980. Contract AS02-76ET53051. 8p. (CONF-810214—2). NTIS, PC A02/MF A01.

From 4. topical conference on radio frequency plasma heating; Austin, TX, USA (9 Feb 1981).

Preliminary ICRH experiments have begun on the Wisconsin Levitated Octupole. In order to study heating, energy confinement, and high β plasmas, a 1.8 to 3 MHz oscillator and antenna have been installed. The oscillator and antenna have been installed. The oscillator is capable of delivering 2 MW of RF power for 10 msec, and to date up to 0.5 MW has been coupled into the plasma. At a density of $\sim 6 \times 10^{12}$ cm^{-3}, T/sub e/ reaches a maximum of 30 eV as measured by Langmuir probes and VUV spectroscopy. Charge exchange measurements of T/sub i/ show Maxwellian components at 95 and 190 eV, with an energy confinement time of $\sim$ 1 msec. Electron energy confinement is limited by impurity radiation, and several methods of impurity control are being tested. Current experiments also include direct measurement of the RF electric field, antenna loading measurements, variation of the oscillator frequency, and ohmic heating of the electrons.

11819 (DOE/ET/53051—16) Alfven wave heating studies in Tokapole II. Witherspoon, F.D.; Kieras, C.E.; Sprott, J.C.; Prager, S.C. (Wisconsin Univ., Madison (USA)). Dec 1980. Contract AS02-76ET53051. 8p. (CONF-810214—1). NTIS, PC A02/MF A01.

From 4. topical conference on radio frequency plasma heating; Austin, TX, USA (9 Feb 1981).

Coupling to shear Alfven wave resonances has been suggested as a promising heating scheme for tokamaks. This technique is being experimentally investigated in Tokapole II. Resonances in the poloidal magnetic wave field have been observed during the RF pulse with resonant peaks on both sides of the separatrix. The location and mode structure of these peaks are consistent with theoretical calculations for the noncircular tokamak plasma indicating the strong possibility that shear Alfven wave resonances are being observed in a tokamak geometry. At present, only basic wave excitation and propagation studies are being performed, with heating studies to follow later.

11820 (LA-UR—81-304) Los Alamos field-reversed configuration (FRC) research. Armstrong, W.T.; Bartsch, R.R.; Cochrane, J.C.; Linford, R.K.; Lipson, J.; McKenna, K.F.; Platts, D.A.; Sherwood, E.G.; Siemon, R.E.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 16p. (CONF-810212—1). NTIS, PC A02/MF A01.

From US/Japan joint workshop on compact toroids; Osaka, Japan (Feb 1981).

Recent experimental results are discussed for a compact toroid produced by a field-reversed theta-pinch and containing purely poloidal magnetic fields. The confinement time is found to vary inversely with the ion gyro-radius and to be approximately independent of ion temperature for fixed gyro-radius. Within a coil of fixed radius, the plasmoid major radius R was varied by $\sim$ 30% and the confinement appears to scale as R^2. A semi-empirical formation model has been formulated that predicts reasonably well the plasma parameters as magnetic field and fill pressure are varied in present experiments. The model is used to predict parameters in larger devices under construction.

11821 (PPPL—1733) Confinement studies during neutral beam injection in PLT. Goldston, R.; Davis, S.; Eubank, H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Dec 1980. Contract AM02-76CH03073. 21p. NTIS, PC A02/MF A01.

Neutral beam injection experiments on PLT have provided definitive information on ion energy confinement in highly collisionless plasmas. We find that ion thermal conduction is consistent, within a factor of $\sim$ 3, with neoclassical theory, and that anomalous thermal convection of ion energy is a factor of 2-3 less than would be calculated from the INTOR D/sub e/ with a convection loss term of the form 5/2nkTv/sub r/. From our experiments with a shunted TF coil we have found that a single shallow ripple well of 2.5% has a neglible effect on ion energy confinement, even at the lowest collisionality obtainable on PLT. Scrutiny of the analytic theories of ripple induced transport motivated by these experiments, suggests that more theoretical (and perhaps numerical) work is needed in this area.

11822 (PPPL—1734) Observation of neoclassical effects on neutral beam injected ions in PLT. Kaita, R.; Goldston, R.J.; Bussac, J.P. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1981. Contract AM02-76CH03073. 29p. NTIS, PC A03/MF A01.

The horizontally-scanning charge exchange analyzer on the Princeton Large Torus (PLT) was used to measure fast co-moving ions during counter-injection of neutral beams. The large flux of charge exchange neutrals observed under these circumstances exhibited a sharp cutoff as the analyzer was moved toward more parallel radii of tangency. At a fixed angle and beam energy, the cutoff showed a strong dependence on the plasma current. Monte-Carlo calculations using a Fokker-Planck formalism and full toroidal geometry give substantive agreement with the experimental data, indicating that neoclassical effects on neutral beam injected ions were directly observed.

11823 (PPPL—1738) Limiting beta of stellarators with no net current. Strauss, H.R.; Monticello, D.A. (Princeton Univ., NJ (USA). Plasma Physics Lab.; New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). Jan 1981. Contract AM02-76CH03073. 36p. NTIS, PC A03/MF A01.

Using reduced nonlinear MHD equations, we find finite beta, resistive, $l = 2$ stellarator equilibria with no net current. We then investigate stability to low mode number internal MHD modes, and find beta limits comparable to tokamaks. Low shear equilibria appear to be substantially more stable than high shear.

11824 (PPPL—1745) Universal behaviour in families of area preserving maps. Greene, J.M.; MacKay, R.S.; Vivaldi, F.; Feigenbaum, M.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1981. Contract AM02-76CH03073. 58p. NTIS, PC A04/MF A01.

We have investigated numerically the behaviour, as a perturbation parameter is varied, of periodic orbits of some reversible area preserving maps of the plane. Typically, an initially stable periodic orbit loses its stability at some parameter value and gives birth to a stable orbit of twice the period. An infinite sequence of such bifurcations is accomplished in a finite parameter range.

11825 (PPPL—1748) Stability limit of A $l = 3$ linear helical stellarator. Yoshikawa, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1981. Contract AM02-76CH03073. 10p. NTIS, PC A02/MF A01.

The stability limit of a linear helical system with small magnetic axis expansion was calculated.

11826 **(SAI—254-80-650-LJ) Nonlinear saturation of the lower-hybrid-drift instability.** Myra, J.R.; Aamodt, R.E. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Nov 1980. Contract AC03-76ET53057. 12p. (PRI—19). NTIS, PC A02/MF A01.

The nonlinear evolution of the lower-hybrid-drift instability is considered in the guiding-centers-on-axis model. Extremely rapid radial quasilinear diffusion of electrons leads to the buildup of a radial electric field, vector E/sub r/. Saturation occurs when the vector E/sub r/ x vector B electron drift velocity equals the local ion rotational velocity. Due to the rapid linear growth rate, the unmagnetized ions here are unable to shield out vector E/sub r/, which becomes significant long before density profile flattening occurs.

11827 **(SAI—254-81-009-LJ) Omnigenous equilibria.** Catto, P.J.; Hazeltine, R.D. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Jan 1981. Contract AC03-76ET53057. 18p. (PRI—21). NTIS, PC A02/MF A01.

Scalar pressure equilibria in which the divergence of the parallel current density vanishes, are shown to be free of neoclassical transport, for any asymmetry, any plasma beta, and in any collisionality regime. The explicit constraint that eliminates neoclassical effects in a long, thin mirror equilibrium in the low beta limit is derived, and some model fields considered.

11828 **Optical measurements of lateral energy flow and plasma motion in laser-produced plasmas.** Benjamin, R.F.; Riffle, J.H. (Los Alamos Scientific Lab., NM). *SPIE (Society of Photo-Optical Instrumentation Engineers) Seminar Proceedings ;* **190**: 259(1979).

An optical system consisting of a telephoto lens and multiimage camera is described and the experimental results and their implications are presented. We will also describe the opto-electronic system that will measure the time history of the energy flow with sub-nanosecond resolution. The system will be useful to study both one- and two-dimensional geometries. The third optical diagnostic is a laser probe utilizing detection by the opto-electronic system mentioned above. This diagnostic measures plasma motion as well as energy flow. The laser probe and detection system mounts directly onto the target chamber at LASLs Gemini CO_2 laser, causing severe alignment and stability problems whose solutions will be shown.

7002 Fusion Power Plant Technology

11829 **(ANL/FPP—80-1(Vol.1)) STARFIRE: a commercial tokamak fusion power plant study.** (Argonne National Lab., IL (USA)). Sep 1980. Contract W-31-109-ENG-38. 859p. NTIS, PC A99/MF A01.

STARFIRE is a 1200 MWe central station fusion electric power plant that utilizes a deuterium-tritium fueled tokamak reactor as a heat source. Emphasis has been placed on developing design features which will provide for simpler assembly and maintenance, and improved safety and environmental characteristics. The major features of STARFIRE include a steady-state operating mode based on continuous rf lower-hybrid current drive and auxiliary heating, solid tritium breeder material, pressurized water cooling, limiter/vacuum system for impurity control and exhaust, high tritium burnup and low vulnerable tritium inventories, superconducting EF coils outside the superconducting TF coils, fully remote maintenance, and a low-activation shield. A comprehensive conceptual design has been developed including reactor features, support facilities and a complete balance of plant. A construction schedule and cost estimate are presented, as well as study conclusions and recommendations.

11830 **(ANL/FPP—80-1(Vol.2)) STARFIRE: a commercial tokamak fusion power plant study.** (Argonne National Lab., IL (USA)). Sep 1980. Contract W-31-109-ENG-38. 863p. NTIS, PC A99/MF A01.

This volume contains chapters on each of the following topics: (1) radioactivity, (2) heat transport and energy conversion, (3) tritium systems, (4) electrical storage and power supplies, (5) support structure, (6) cryogenics, (7) instrumentation and control, (8) maintenance and operation, (9) balance of plant design, (10) safety and environmental analysis, (11) economic analysis, and (12) plant construction.

11831 **(EGG-FSP—5238) Fusion safety program plan.** Crocker, J.G.; Holland, D.F.; Herring, J.S. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1980. Contract AC07-76ID01570. 203p. NTIS, PC A10/MF A01.

The program plan consists of research that has been divided into 13 different areas. These areas focus on the radioactive inventories that are expected in fusion reactors, the energy sources potentially available to release a portion of these inventories, and analysis and design techniques to assess and ensure that the safety risks associated with operation of magnetic fusion facilities are acceptably low. The document presents both long-term program requirements that must be fulfilled as part of the commercialization of fusion power and a five-year plan for each of the 13 different program areas. Also presented is a general discussion of magnetic fusion reactor safety, a method for establishing priorities in the program, and specific priority ratings for each task in the five-year plan.

11832 **(LA-UR—80-3579) Inorganic insulator program at LASL.** Clinard, F.W. Jr.; Parkin, D.M. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 14p. (CONF-801237—1). NTIS, PC A02/MF A01.

From Meeting on electrical insulators for fusion magnets; Germantown, MD, USA (15 Dec 1980).

Experiments are conducted to determine electrical and structural changes resulting from neutron and ionizing radiation. Calculations were made of damage effects in compounds and the dependence of this damage on neutron energy was studied. These activities are outlined. (MOW)

11833 **(LA-UR—81-269) Comparison between an SCR and a vacuum interrupter system for repetitive opening.** Parsons, W.M. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 14p. (CONF-810118—1). NTIS, PC A02/MF A01.

From Army research office workshop on repetitive opening switches; Durango, CA, USA (29 Jan 1981).

Two conceptual systems are analyzed for repetitive interruption of current from an inductive energy storage source. The interruption level for both systems is 25 kA at 25 kV. Factors such as interruption frequency, power dissipation, reliability, maintenance, developmental time, and cost are compared. The vacuum interrupter system is considered feasible for an interruption frequency of 25 Hz and a 10 to 20% duty cycle. The SCR system is considered feasible for an interruption frequency of up to 10 kHz.

11834 **(LA-UR—81-325) Compact toroids generated by a magnetized coaxial source in the CTX experiment.** Sherwood, A.R.; Henins, I.; Hoida, H.W.; Jarboe, T.R.; McKenna, K.F.; Linford, R.K.; Marshall, J.; Platts, D.A. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 10p. (CONF-810212—2). NTIS, PC A02/MF A01.

From US/Japan joint workshop on compact toroids; Osaka, Japan (Feb 1981).

Compact toroids containing both toroidal and poloidal magnetic field (Spheromak-type) have been generated in CTX using a magnetized coaxial plasma gun. These CTs tear loose from the gun by magnetic field line reconnection, and they are trapped in flux conservers having various geometries. In a straight cylindrical flux conserver the CTs are observed to be unstable to a gross tilting mode. Stability to the tilting mode has been demonstrated in flux conservers having an oblate trapping region; however, the geometry of the entrance region leading to the trapping volume can also have important effects. Lifetimes of about 150 μs for the CTs are typically observed. Interferometric measurements give a value of about 2×10^{14} cm^{-3} for the initial plasma density. The plasma temperature measured at a single spot near the minor magnetic axis decreases to around 10 eV by the time the magnetic reconnection is complete. Spectrographic measurements and pressure probe results are in agreement with this temperature. A snipper coil has been in-

stalled to induce the CT to tear loose from the gun sooner. The use of this coil is observed to speed up the magnetic field reconnection process by about a factor of 2.

11835 (PPPL—1732) Effect of hydrogen glow discharge conditioning on Zr/Al getter pumps. Dylla, H.F.; Cecchi, J.L.; Ulrickson, M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1981. Contract AM02-76CH03073. 16p. NTIS, PC A02/MF A01.

Zr/Al bulk getter pumps are presently being considered for use in the Tokamak Fusion Test Reactor (TFTR) to reduce impurities and limit the recycling of hydrogenic species. It is necessary that these pumps not be adversely affected by the hydrogen glow discharge cleaning (GDC) which is planned as part of the routine TFTR vessel wall conditioning. The GDC procedure involves the use of a dc glow discharge with a 400 V bias voltage. The total fluence of hydrogenic ions given to the affected surfaces during a typical conditioning period is 10^{18} cm^{-2}. We have investigated the effects of typical GDC runs on a getter-pump module containing 25 g of Zr/Al mounted in a 100 liter test stand. Pumping speed, capacity, and regeneration characteristics have been studied after various exposures to GDC.

11836 (UCID—18902) Fire protection research for energy technology projects; FY 79 year-end report. Hasegawa, H.K.; Alvares, N.J.; Lipska, A.E.; Ford, H.; Beason, D.G. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Jan 1981. Contract W-7405-ENG-48. 92p. NTIS, PC A05/MF A01.

This report describes work performed in fiscal year 1979, on a DOE funded study entitled Fire Protection Research for Energy Technology Projects. The primary goal of this program is to ensure that fire protection measures for Fusion Energy Experiments (FEE) evolve concurrently with the complexity of FEE. Ultimately, it is planned that the detailed study of fusion experiments will provide an analytical methodology which can be applied to the full range of energy technology projects. We attempt to achieve this objective by coordinately advancing 3 (three) major task areas; (a) determine the fire hazards of current FEE facilities (b) assess the ability of accepted fire management strategies to meet and negate the hazard, (c) perform unique research into problem areas we have identified to provide input into analytical fire growth and damage assessment models.

11837 (UCRL—83304) Laser-induced damage measurements with 266-nm pulses. Deaton, T.F.; Smith, W.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Jan 1980. Contract W-7405-ENG-48. 12p. (CONF-7910101—3). NTIS, PC A02/MF A01.

From Symposium on optical materials for high power lasers; Boulder, CO, USA (30 Oct 1979).

The results of a survey of laser-induced damage thresholds for optical components at 266 nm are reported. The thresholds were measured at two pulse durations--0.150 ns and 1.0 ns. The 30 samples tested include four commercial dielectric reflectors, three metallic reflectors, two anti-reflection films, a series of eight half-wave oxide and fluoride films, and twelve bare surfaces (fluoride crystals, silica, sapphire, BK-7 glass, CD*A and KDP). The 266-nm pulses were obtained by frequency-quadrupling a Nd:YAG, glass laser. Equivalent plane imagery and calorimetry were used to measure the peak fluence of each of the UV pulses with an accuracy of +- 15%; the uncertainty in the threshold determinations is typically +- 30%.

11838 Sputtering of annealed aluminum and of sintered aluminum powder (Sap 895) under D/sup +/ and /sup 4/He/sup +/ bombardment: study of microstructural effects. Lam, S.K.; Kaminsky, M. (Argonne Natl Lab, Ill). *Journal of Nuclear Materials (Journal des Materiaux Nucleaires) ;* **89**: No. 2-3, 205-220(Apr 1980).

The equivalent Al thickness and the chemical composition of the sputter deposits were analyzed by (1) Rutherford backscattering (RBS), (2) peak-to-peak amplitude measurement using Auger electron spectroscopy (AES), and (3) sputter depth profiling with AES. For D/sup +/ irradiations of annealed Al and SAP 895 no detectable difference in the yields for sputtered aluminum have been observed. For He/sup +/ irradiations, the yields for SAP 895 are 5 to 18% higher. 32 refs.

11839 Formulation of plasma transport in the laser-fusion regime. Brysk, H. (Los Alamos Scientific Lab., NM). *Transport Theory and Statistical Physics ;* **8**: No. 4, 193-218(1979).

The Braginskii system of fluid equations has been extended up to the flux moment of the Vlasov equation. The collision terms and higher moments have been evaluated explicitly with the distribution functions approximated by drifting Maxwellians and obtained in closed form. The resulting formulation is a reasonable representation for the region of parameter space corresponding to a laser-fusion plasma on the low-density side of the critical density, where flux-limiters have been invoked.

11840 (LA-UR—81-94) Saturation of hot CO_2 at 10.6 μm. Goldstein, J.C.; Czuchlewski, S.J.; Nowak, A.V. (Los Alamos Scientific Lab., NM (USA)). [nd]. Contract W-7405-ENG-36. 15p. (CONF-801201—6). NTIS, PC A02/MF A01.

From 3. international conference on lasers and applications; New Orleans, LA, USA (15 Dec 1980).

Saturation of the short laser pulse transmission of hot CO_2 has been studied experimentally and theoretically. Pure CO_2 at 200 torr and 400 +- 3°C was contained in a special temperature-controlled 118 cm absorption cell. The cell's energy transmission was measured as a function of the incident pulse's fluence. The incident pulses' wavelengths were either at the P18 or P20 lines of the 10.6 μm band, and their temporal shape (FWHM of 1.6 ns) was kept fixed as the fluence was changed. The data showed that the absorption of hot CO_2 saturated differently at the two wavelengths, with the P20 transition being the harder to saturate.

99 GENERAL AND MISCELLANEOUS

9901 Management

11841 (LA-UR—81-82) Continuing education through computer-aided instruction. Fox, J. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 10p. (CONF-810416—1). NTIS, PC A02/MF A01.

From IEEE region 6 conference on electrical engineering applications in the pacific; Honolulu, HI, USA (1 Apr 1981).

Computer-aided and managed instruction has been incorporated into the continuing education program in the Electronics Division of the Los Alamos National Laboratory. Two Control Data Corporation PLATO terminals have been installed in the learning center, and have been providing individualized instruction to the employees for approximately 2 years. Reactions from users and total usage figures indicate that there are unique advantages to computer-aided instruction. User interaction with a computer assures individual response from a student. The learner must be actively involved in the course and cannot passively allow content to flow by. Complex simulations can be programed and used in the learning process; thus, expensive equipment can be spared the wear and tear attributed to learners. The breadth of course topics included in the on-line library assures that PLATO has a continuing education offering for most employees. New lessons appear on line at the rate of three or four per week; PLATO cost effectiveness is thus certified. Comparisons of courses taken on the terminal to the same or similar courses offered elsewhere indicate that PLATO is advantageous. Computer-aided instruction is available when the learner is ready for initial instruction and later for reviews. At Los Alamos, the demand for PLATO service is growing. The Laboratory will have eight terminals installed and operating by April 1981. 8 tables.

11842 (LA-UR—81-192) Role of military scientists and engineers in space (1980-2000). Angelo, J.A. Jr. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 20p. (CONF-810418—1). NTIS, PC A02/MF A01.

From Military space doctrine symposium; Colorado Springs, CO, USA (1 Apr 1981).

The Space Transportation System provides military scientists and engineers exciting new capabilities to conduct a variety of pio-

neering experiments on orbit, taking unique advantage of the space environment itself or observing the planet firsthand from the vantage point of space. The reusable Shuttle/Spacelab configuration permits a more effective use of the human and material resources being committed to the space program in the next decade, and ensures the presence of man in space on a routine basis. However, full-scale exploitation of space for national defense will depend to a great extent on the skillful and successful utilization of the military payload specialists, who will fly and operate various Shuttle-based DoD experiments. This paper explores the doctrine, role, function, and training requirements for DoD payload specialists. The unique advantage of man-in-the-loop activities and the orbiting military scientist conducting experiments in situ is addressed in light of previous US manned space flight experience and the projected capabilities of the Shuttle. 4 figures.

11843 **(UCID—18846) Fund usage program.** Orvis, W.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Dec 1980. Contract W-7405-ENG-48. 37p. NTIS, PC A03/MF A01.

The fund usage program is an accounting-type program designed to print plot and archive costs related to project management. Project costs are differentiated with four subaccounts: consultants, subcontracts billed, subcontracts liens, and internal. Data are accumulated monthly and processed by account and by fiscal year. The number of accounts and the number of account data files is limited only by the capacity of a program tape. Plotting of data differentiates each subaccount, the total costs, and the spending limit. These plots can be used to recognize trends in spending patterns, especially in relation to the spending limit. All input data are automatically archived and updated to maintain a complete record of all past trends.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 10226, 10374, 10379, 10843, 10943

11844 (FE—2215-13(Vol.3), pp 22) **Method for the automatic generation of triangular elements from a surface.** Cohen, H.D. (Massachusetts Inst. of Tech., Cambridge). Apr 1979.

In Critical contributions in MHD power generation. Final technical progress report, June 1, 1975-December 30, 1978.

An algorithm is given to discretize a polygon or curved surface into triangular arrays. The method first involves the manual division of the array into quadrilaterals with specified number on rows and columns. The individual points then are filled in automatically and the elements are automatically generated. The number of columns or rows in the quadrilateral may be made to change. A subroutine (FGRID) is listed that performs this task. FGRID has been used to discretize an octagon for calculations of MHD flows.

11845 **(LA-UR—80-3502) Decision graphs: a tool for developing real-time software.** Kozubal, A.J. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 7p. (CONF-810311—1). NTIS, PC A02/MF A01.

From 2. international conference and exhibition on engineering software; London, UK (24 Mar 1981).

The use of decision graphs in the preparation of, in particular, real-time software is briefly described. The usefulness of decision graphs in software design, testing, and maintenance is pointed out. 2 figures. (RWR)

11846 **(LA-UR—81-270) Vectorization of algorithms for solving systems of difference equations.** Buzbee, B.L. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 10p. (CONF-810113—1). NTIS, PC A02/MF A01.

From Simulation methods for nuclear power systems conference; Tucson, AZ, USA (Jan 1981).

Today's fastest computers achieve their highest level of performance when processing vectors. Consequently, considerable effort has been spent in the past decade developing algorithms that can be expressed as operations on vectors. In this paper two types of vector architecture are defined. A discussion is presented on the variation of performance that can occur on a vector processor as a function of algorithm and implementation, the consequences of this variation, and the performance of some basic operators on the two classes of vector architecture. Also discussed is the performance of higher-level operators, including some that should be used with caution. With both types of operators, the implementation of techniques for solving systems of difference equations is discussed. Included are fast Poisson solvers and point, line, and conjugate-gradient techniques. 1 figure.

11847 **(LA-UR—81-284) Online microfilm recorders at Los Alamos National Laboratory.** Wolf, R. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 15p. (CONF-810213—1). NTIS, PC A02/MF A01.

From 11. annual computer output microfilm technology conference; Lincolnshire, IL, USA (Feb 1981).

The Los Alamos Computing Division has developed a satellite graphics output station (PAGES). This station accepts user requests for output through a large computer network (the ICN). The system orders these requests and schedules output on one of several devices consistent with the user's request and the overall job turnaround requirements of the Laboratory. The system translates a standard Metafile into a device-specific format and efficiently generates the requested output. At the same time, PAGES provides some graphics processing, previously provided by the large supercomputers. The system provides current information on queues, jobs being processed, and the devices. An effective quality control program is an integral part of the system design. This system should continue to reduce user interface changes, hold down operating cost, make effective use of supercomputer time, and produce quality output. 10 figures, 1 table.

11848 **(LBL—11847) RATMAC primer.** Munn, R.J.; Stewart, J.M.; Norden, A.P.; Pagoaga, M.K. (Maryland Univ., College Park (USA). Div. of Agricultural and Life Sciences; California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 93p. (TR—804). NTIS, PC A05/MF A01.

A brief summary of the concept of structured programming and preprocessors is given, and the RATFOR and RATMAC structured languages are described. Control and decision structures are discussed along with other features of the language such as file inclusion, symbolic constants, and macros. RATMAC code, the generated FORTRAN, and program execution results for two sample RATMAC programs are given. (RWR)

11849 **(SAND—80-2205) Megaflop comparisons of various computers.** Jefferson, T.H.; Scott, M.R. (Sandia National Labs., Livermore, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). Oct 1980. Contract AC04-76DP00789. 10p. NTIS, PC A02/MF A01.

A test program and results obtained by running this program on a wide range of computers of interest to Sandia National Laboratories are described. The program, written in FORTRAN, was designed to estimate the speed with which a target computer could perform floating-point operations requested by a FORTRAN programer. Input/output operations are not timed. Thus, the results depend not only upon the basic underlying speed of the computer, but also upon the intelligence of the FORTRAN compiler. 2 tables.

11850 **(SAND—80-2562) General overview of MADDS/VAX network support and release software.** Burd, W.C.; Yates, A.L. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 15p. NTIS, PC A02/MF A01.

A general description of the VAX programs that are utilized by the 2400 MADDS designers is given. These software packages include 2D and 3D GERBER postprocessing, programs that perform Calcomp code postprocessing from GERBER and 2D APPLE files. The VAX drawing release system is also described. 2 figures.

11851 **(SU—326-P,39-37) Studies in the organization of computer systems. Final report.** Flynn, M.J. (Stanford Univ., CA (USA). Dept. of Electrical Engineering; Stanford Univ., CA (USA). Dept. of Computer Science). Jul 1979. Contract AT03-76ER70039. 19p. NTIS, PC A02/MF A01.

This project has studied theoretical and practical methods of the categorization, analysis, and synthesis of computing systems. In particular, an Emulation Laboratory has been developed for the analysis of computer architectures and interpretive computer designs. A memory hierarchy management study has developed techniques to improve the performance of multilevel virtual memory systems. Efforts in the areas of parallel processors and program representation have continued. 2 figures, 4 tables.

11852 **(TM—337) Batch processing at ANL.** Peavler, J. (ed.). (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 71p. NTIS, PC A04/MF A01.

This document explains how to use the facilities available for batch (non-interactive) processing at the Central Computing Facility (CCF) of Argonne National Laboratory. The first part contains an overview of batch jobs, some samples with discussion, and some detailed discussion of the information needed to run simple jobs. The second part contains more technical information describing in more detail those aspects of the batch system that differ from the descriptions in the manuals provided by computer manufacturers. 8 tables. (RWR)

11853 **(UCID—18864) Evaluation report on the Initial Graphics Exchange Specification (IGES).** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Jan 1981. Contract W-7405-ENG-48. 43p. NTIS, PC A03/MF A01.

IGES is a communication file structure for data produced on and used by computer-aided design/computer-aided manufacturing (CAD/CAM) systems in widespread use today. It is intended to provide a means for data interchange between CAD/CAM systems of different brand name, and to allow the transfer of geometric data to and from external applications programs. IGES represents an initial organized attempt to address and resolve the interface problems that arise as a result of the introduction of the computer into the design and manufacturing environment by introducing a set of specifications where none presently exists. This report gives an overview of IGES progress as of April 1980. 5 figures, 1 table. (RWR)

11854 **(UCRL—82926) LR: automatic parser generator and LR(1) parser.** Wetherell, C.; Shannon, A. (California Univ., Davis (USA). Dept. of Animal Science; California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Jun 1979. Contract W-7405-ENG-48. 18p. NTIS, PC A02/MF A01.

LR is an LR(a) parser generation system. It is written entirely in portable ANSI standard FORTRAN 66, and has been successfully operated on a number of computers. LA uses a powerful algorithm to generate a space-efficient parser for any LR(1) grammer. Generated parsers have been used in a variety of compilers, utility programs, and applications packages. 6 figures.

11855 **(UCRL—85293) ODE solvers for use with the method of lines.** Hindmarsh, A.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1980. Contract W-7405-ENG-48. 9p. (CONF-8006145—1). NTIS, PC A02/MF A01.

From IMACS symposium on computer methods for PDE's; Bethlehem, PA, USA (30 Jun 1980).

The numerical method of lines for time-dependent PDE's or PDE systems requires effective and flexible solvers for systems of ordinary differential equations (initial-value problem). The ODE system can be explicit or implicit in form, and is typically large, complex, and stiff. Various solvers have been written and used in this context, most using the BDF methods first introduced in software form by Gear. Recently, two new solvers have been developed and released, in which flexibility, portability, and ease of use (both generally and for method of lines applications) were prime design criteria: LSODE solves explicit systems y-dot = f(t, y), and LSODI solves linearly implicit systems A(t, y) y-dot = g(t, y), where A is a square matrix.

11856 **Monotone piecewise cubic interpolation.** Fritsch, F.N. (Univ. of California, Livermore); Carlson, R.E. Contract W-7405-ENG-48. *SIAM (Society for Industrial and Applied Mathematics) Journal on Numerical Analysis ;* **17**: No. 2, 238-246(Apr 1980).

Necessary and sufficient conditions are derived for a cubic to be monotone on an interval. These conditions are used to develop an algorithm that constructs a visually pleasing monotone piecewise cubic interpolant to monotone data. Several examples are given that compare this algorithm with other interpolation methods. 5 figures.

11857 **Standard interfacing scheme for Micronova computers.** Hardesty, P.T.; Lyons, J.W.; Faulkner, L.R. Contract EY-76-C-02-1198. *American Laboratory ;* **12**: No. 2, 55-57(1980).

An interface to connect a variety of devices to a packaged Micronova minicomputer (Data General Corporation) was developed. The goal was to produce a flexible, general interface scheme, so that expanded application to other devices would not require detailed dealings with the Micronova architecture or extensive development time. Part of the solution is the use of a standardized external backplane for communication between the Micronova and peripheral devices.

11858 **Computer as a physical system: a microscopic quantum mechanical Hamiltonian model of computers represented by Turing machines.** Benioff, P. (CNRS, Marseilles, France). *Journal of Statistical Physics ;* **22**: No. 5, 563-591(1980).

A microscopic quantum mechanical model of computers as represented by Turing machines is constructed. It is shown that for each number N and Turing machine Q there exists a Hamiltonian H/sub N//sup Q/ and a class of appropriate initial states such that, if PSI/sub Q//sup N/(0) is such an initial state, then PSI/sub Q//sup N/(t) = exp(-iH/sub N//sup Q/t) PSI/sub Q//sup N/(0) correctly describes at times t_3, t_6,..., t/sub 3N/ model states that correspond to the completion of the first, second,..., Nth computation step of Q. The model parameters can be adjusted so that for an arbitrary time interval Δ around t_3, t_6,..., t/sub 3N/, the machine part of PSI/sub Q//sup N/(t) is stationary. 1 figure.

11859 **Decomposability in fixed point computation with applications and acceleration techniques.** Solow, D. (Stanford Univ., CA). *Journal of Mathematical Analysis and Applications ;* **71**: No. 2, 558-579(Oct 1979).

In the past decade, several complementary pivot algorithms have been developed to search for fixed points of certain functions and point to set maps on unbounded regions. This paper develops a structure (called decomposability), which, when present, enables one to work in a lower-dimensional space when solving these problems. Several examples of where this structure arises in applications are presented. It is shown that under suitable circumstances, the general constrained optimization problem (that of optimizing an objective function subject to both equality and inequality constraints) may be formulated as a decomposable fixed point problem. At the same time, an approximation technique is developed potentially to improve the efficiency of the complementary pivot algorithms.

11860 **Principles of discrete event simulation.** Fishman, G.S. New York, NY; John Wiley and Sons (1978). 532p. $24.50.

According to the author of the book, it is meant to describe concepts, methods, and procedures for modeling the behavior of a discrete event system, for translating the model into code executable on a digital computer, and for analyzing sample sequences that emerge from the program's execution. A revision of an earlier text, the current version incorporates many recent developments in discrete event simulation. In the opinion of the reviewer, the idea of the book is quite good, but the author is not successful in providing a text that clearly explains the recent developments. (RWR)

9903 Information Handling

11861 **(CONF-8010139—(Absts)) Proceedings of the 1980 integrated county-level-data user's workshop.** Olson, R.J. (ed.). (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-26. 67p. NTIS, PC A04/MF A01.

From Integrated county-level-data users workshop; Reston, VA, USA (15 Oct 1980).

Counties are used as spatial cells for many regional and national studies of environment, energy, health, and socioeconomics. Many agencies routinely collect county data for their specific mission-oriented needs; these files must be obtained, reformatted, edited, and integrated with other files for regional study needs. It is essential that county-level data be used in the most efficient way. The objectives of this workshop were to: provide a forum for exchanging ideas, methods, and data; inventory currently available data; identify needed data; establish a directory of people-contacts; and develop guidelines for exchanging thematic data. Abstracts of papers and discussion group summaries are given. (RWR)

11862 **(DOE/EIA/11581—T1) Energy Emergency Management Information System (EEMIS): functional requirements.** (Wilson-Hill Associates, Inc., Washington, DC (USA)). 17 Oct 1980. Contract AC01-80EI11581. 48p. NTIS, PC A03/MF A01.

This report deals with the functional requirements of the Energy Emergency Management Information System (EEMIS) as it is defined for State level use (EEMIS-S). This report provides a technical description of the EEMIS-S requirements. These guidelines state that in order to create the widest practicable competition the system's requirements, with few exceptions, must be expressed in functional terms without reference to specific hardware or software products, and that wherever exceptions are made a statement of justification must be provided. In addition, these guidelines set forth a recommended maximum threshold limit of annual contract value for schedule contract procurements. Section 2.0 presents a general overview of the EEMIS structure in terms of requirements for vendor support. The functional requirements for each component are developed by section as: Teleprocessing Monitor Requirements, Section 3.0; EEMIS File Requirements, Section 4.0; Data Base Management Requirements, Section 5.0; Application Program Requirements, Section 6.0; and Utility Program Requirements, Section 7.0. The final Section, 8.0, justifies the use of the GSA Teleprocessing Service Program - Multiple Award Schedule Contracts (TSP-MASC) procurement process. The intent of this section is to substantiate, in this instance, the desirability of obtaining time-sharing vendor services to support EEMIS under a schedule contract, even if certain TSP-MASC threshold limits might be exceeded.

11863 **(DOE/EIA/11581—T2) Benchmark script and evaluation criteria.** (Wilson-Hill Associates, Inc., Washington, DC (USA)). 31 Oct 1980. Contract AC01-80EI11581. 21p. NTIS, PC A02/MF A01.

The Department of Energy's Office of Energy Emergency Management Information System requires time-sharing and remote-job-entry services for their state Energy Emergency Management Information System (EEMIS-S). The Office is soliciting time-sharing services through use of GSA's Teleprocessing Service Program - Multiple Award Schedule Contracts (TSP-MASC) process. The functional mandatory and desirable requirements that candidate vendors should provide are described in the Functional Requirements Document (DOE/EIA/11581-T1). This document, DOE/EIA/11581-T2, describes the Benchmark Scenario and Vendor Evaluation Criteria. Section 1.0 describes the Benchmark, the Benchmark Evaluation, and the Workload Definition. The Vendor Evaluation Criteria and mandatory and desirable hardware and service checklists are described in Section 2.0. To provide compliance with these requirements, a benchmark test will be performed using the vendor's system.

11864 **(DOE/EIA/11581—T3) Benchmark requirements for the Energy Emergency Management Information System (EEMIS). Phase 1. Work plan.** (Wilson-Hill Associates, Inc., Washington, DC (USA)). 22 Sep 1980. Contract AC01-80EI11581. 17p. NTIS, PC A02/MF A01.

EEMIS has responsibility for providing special information and communication services to government officials, at Federal and state levels, who must deal with energy emergencies. Because of proprietary information residing in the data base used for Federal purposes, a special system (EEMIS-S) must be established for use by the states. It is planned to acquire teleprocessing services for EEMIS-S from a time-sharing commercial vendor, and the process for procurement must meet guidelines for approval. The work plan and schedule for meeting these guidelines are discussed. Tasks to be included contain estimates of time, cost, and resources required, all of which are briefly described.

11865 **(UCID—18906) Non-unique key B-Tree implementation.** Ries, D.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Dec 1980. Contract W-7405-ENG-48. 48p. NTIS, PC A03/MF A01.

The B-Trees are an indexed method to allow fast retrieval and order preserving updates to a FRAMIS relation based on a designated set of keys in the relation. A B-Tree access method is being implemented to provide indexed and sequential (in index order) access to FRAMIS relations. The implementation modifies the basic B-Tree structure to correctly allow multiple key values and still maintain the balanced page fill property of B-Trees. The data structures of the B-Tree are presented first, including the FRAMIS solution to the duplicate key value problem. Then the access level routines and utilities are presented. These routines include the original B-Tree creation; searching the B-Tree; and inserting, deleting, and replacing tuples on the B-Tree. In conclusion, the uses of the B-Tree access structures at the semantic level to enhance the FRAMIS performance are discussed. 10 figures.

11866 **(UCID—18920) FRAMIS concurrency control.** Ries, D.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Dec 1980. Contract W-7405-ENG-48. 12p. NTIS, PC A02/MF A01.

The FRAMIS concurrency control is used to insure data base consistency when multiple users are updating and reading from a database. In a shared FRAMIS database, users can read or write any of the permanent tables. The FRAMIS concurrency control will guarantee that, while one FRAMIS command is being processed, no other user will update the tables being read and no other user will read data from the table being updated. Once the command has been finished, the updated table will be available to other users. This paper discusses implementation of the FRAMIS concurrency control. The types of locks that must be set and the rules for setting those locks are described. Then the locking actions required for each command are reviewed. Finally, the SERI dependent locking implementation is reviewed. 1 figure. (RWR)

11867 **Education and training for computer-based reference services: a case study.** Robinson, J. (Univ. of California, Berkeley). *Journal of the American Society for Information Science ;* **31**: No. 2, 97-104(Mar 1980).

A training program for on-line searching that was used by the University of California's Computerized Information Services is discussed. After giving an overview of the training program as a whole, the aspect of database training is emphasized. One form of intensive database training is the database workshop, presented by the database supplier staff (often in conjunction with search service staff). A second form is the database seminar, where searchers investigate topics on diverse databases and systems, and then report to each other in an informal setting. This proved to be a popular and cost-effective training technique, especially for search strategy. The two kinds of database training seem to complement each other. 4 figures, 1 table.

9905 Civilian Defense

REFER ALSO TO CITATION(S) 11501

11868 **(AD-A—086244) Feasibility and cost analysis of surge period shelter programs. Final report Mar 79-Jun 80.** Kamath, R.V.; Wright, M.D. (Research Triangle Inst., Research Triangle Park, NC (USA). Applied Ecology Dept.). Jun 1980. 143p. NTIS, PC A07/MF A01.

Protection of the civilian population from the effects of a nuclear attack is one of the goals of the Federal Emergency Management Agency (FEMA). In-place population protection and protection by relocation are two distinct types of civilian protection plans that are used. The in-place plans demand direct effects protection for the entire risk area population, while in the latter case only a skeleton work force needs to be protected. This report describes the investigation into the feasibility and costs of providing all-effects shelters in risk areas for an in-place shelter plan as well as a population relocation plan.

11869 **(AD-A—086738) Upgrading of existing structures. Final report on phase 2.** Gabrielsen, B.L.; Tansely, R.S.; Cuzner, G. (Scientific Service, Inc., Redwood City, CA (USA)). Jun 1980. 203p. NTIS, PC A10/MF A01.

This report presents the results of an investigation of blast upgrading of existing structures, which consisted of developing failure prediction methodologies for various structure types, both in 'as built' and in upgraded configurations, and verifying these prediction techniques with full-scale load tests. These upgrading schemes were developed for use as shelters in support of Civil Defense crisis relocation planning. Structure types investigated included wood, steel, and concrete floor and roof systems. The results of this study are being used in the development of a shelter manual presenting the various upgrading concepts in an illustrative workbook form for use in the field.

11870 **(AD-A—086753) Study of alternate material for pedal ventilator kits. Final report May 79-May 80.** Buday, J.M. (GARD, Inc., Niles, IL (USA)). Apr 1980. 205p. NTIS, PC A10/MF A01.

The objective of this program was to conduct a study of alternate materials that could be utilized in the construction of a pedal ventilator kit (PVK). The goal of the study was to reduce unit cost in a large scale procurement. Cost savings and performance parameters were evaluated using the PVK developed in 1979 under Contract No. DCP01-78-C-0184 as a basis for comparison. A value analysis study was conducted on the PVK to determine viable material/design revisions that offered potential manufacturing economies. Based on the conclusions of the study, one optimum design was chosen for fabrication. Prior to fabrication, five breadboard support frames were constructed and tested. Fifteen fully assembled prototype pedal ventilator kits were constructed. Five of the PVK's were subsequently tested to assure compliance with performance and reliability requirements. Preliminary specifications and operating instructions were generated for the PVK. In addition, production cost estimates based on a procurement of 100,000 units were formulated for FEMA budgetary purposes.

11871 **(PNL—3634) PEDIC: a computer program to estimate the effect of evacuation on population exposure following acute radionuclide releases to the atmosphere.** Strenge, D.L.; Peloquin, R.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1981. Contract AC06-76RL01830. 126p. NTIS, PC A07/MF A01.

The computer program PEDIC is described for estimation of the effect of evacuation on population exposure. The program uses joint frequency, annual average meteorological data and a simple population evacuation model to estimate exposure reduction due to movement of people away from radioactive plumes following an acute release of activity. Atmospheric dispersion is based on a sector averaged Gaussian model with consideration of plume rise and building wake effects. Appendices to the report provide details of the computer program design, a program listing, input card preparation instructions and sample problems.

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DOE Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

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Qualifier
Title, (supplementary information), citation number, (report number)

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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	6:10540	No. 80CH1508-1, 327-331(1980)
	6:10572	No. 80CH1508-1, 109-114(1980)
CONF-800263-	(Symposium on nonpetroleum vehicular fuels, Arlington, VA, USA, 11-13 Feb 1980)	
	6:10417	$40.00
CONF-800264-	(24. American Public Power Association annual engineering and operations workshop, Phoenix, AZ, USA, 25-28 Feb 1980)	
1	6:11082	Library, American Public Power Association, Washington, DC
4	6:10853	Library, American Public Power Association, Washington, DC, $3.00
5	6:11079	Washington, DC; Library, American Public Power Association (1980).

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6	6:11083	Library, American Public Power Association, Washington, DC, $3.00
7	6:11085	Library, American Public Power Association, Washington, DC, $3.00
9	6:10883	Washington, DC; Library, American Public Power Association (1980).
10	6:11084	Library, American Public Power Association, Washington, DC, $3.00
11	6:10854	Library, American Public Power Association, Washington, DC, $3.00
12	6:11081	Library, American Public Power Association, Washington, DC, $3.00
14	6:10855	Library, American Public Power Association, Washington, DC, $3.00
CONF-800334-	(2. DOE environmental control symposium, Reston, VA, USA, 17-19 Mar 1980)	
(Vol.1)	6:10082	NTIS, PC A99/MF A01
(Vol.1)	6:10083	NTIS, PC A99/MF A01
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(Vol.1)	6:10181	NTIS, PC A99/MF A01
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(Vol.1)	6:10194	NTIS, PC A99/MF A01
(Vol.1)	6:10231	NTIS, PC A99/MF A01
(Vol.1)	6:10239	NTIS, PC A99/MF A01
(Vol.1)	6:10285	NTIS, PC A99/MF A01
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(Vol.1)	6:10313	NTIS, PC A99/MF A01
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(Vol.1)	6:10317	NTIS, PC A99/MF A01
(Vol.1)	6:10839	NTIS, PC A99/MF A01
(Vol.1)	6:10861	NTIS, PC A99/MF A01
(Vol.1)	6:11056	NTIS, PC A99/MF A01
(Vol.1)	6:11057	NTIS, PC A99/MF A01
(Vol.1)	6:11526	NTIS, PC A99/MF A01
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(Vol.2)	6:10275	NTIS, PC A99/MF A01
(Vol.2)	6:10291	NTIS, PC A99/MF A01
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(Vol.2)	6:11242	NTIS, PC A99/MF A01
(Vol.2)	6:11530	NTIS, PC A99/MF A01
(Vol.2)	6:11595	NTIS, PC A99/MF A01

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CONF-8003117-	(2. international seminar on the results of EC geothermal energy research, Strasbourg, France, 4-6 Mar 1980)	
	6:10707	Kluwer Boston Inc., Hingham, MA
CONF-8003128-	(Soil Conservation Society of America symposium on adequate reclamation of mined lands, Billings, MT, USA, 26-27 Mar 1980)	
1	6:10187	*See* DOE/EV/70003-11
CONF-800462-	(61. annual meeting of the American Welding Society, Los Angeles, CA, USA, 14-18 Apr 1980)	
2	6:11273	*See* DPSPU-80-30-5
CONF-8004110-	(DOE research conference on CO/sub 2/, Washington, DC, USA, 24-25 Apr 1980)	
	6:11060	NTIS, PC A13/MF A01
	6:11517	NTIS, PC A13/MF A01
	6:11518	NTIS, PC A13/MF A01
	6:11596	NTIS, PC A13/MF A01
CONF-800501-	(15. annual IMPI symposium on microwave powers, Iowa City, IA, USA, 6-9 May 1980)	
2	6:11680	*See* UR-3490-1832
CONF-800540-	(International symposium on highly excited states in nuclear reactions, Osaka, Japan, 12-16 May 1980)	
	6:11780	NTIS (US Sales Only), PC A99/MF A01
CONF-800541-	(Tar sands permeability enhancement workshop, Albuquerque, NM, USA, 8-9 May 1980)	
	6:10245	*See* SAND-80-1651
	6:10298	*See* SAND-80-1651
	6:10299	*See* SAND-80-1651
	6:10303	*See* SAND-80-1651
	6:10304	*See* SAND-80-1651
	6:10305	*See* SAND-80-1651
	6:10308	*See* SAND-80-1651
	6:10309	*See* SAND-80-1651
CONF-8005102-	(Seminar on the beam-beam interaction, Stanford, CA, USA, 22-23 May 1980)	
	6:11461	*See* SLAC-PUB-2624
	6:11462	*See* SLAC-PUB-2624
	6:11463	*See* SLAC-PUB-2624
CONF-8005134-	(Conference on pollen systems to detect biological activity of environmental pollutants, Knoxville, TN, USA, 6-8 May 1980)	
1	6:11634	*See* DOE/EV/72002-48
CONF-8005135-	(EPRI/DOE workshop on nuclear industry valve problems, Washington, DC, USA, 20-21 May 1980)	
	6:10923	*See* SAND-80-1887
	6:10944	*See* SAND-80-1887
	6:10945	*See* SAND-80-1887
	6:10946	*See* SAND-80-1887
CONF-8005136-	(Conference of the Chemical Society of Switzerland, Zurich, Switzerland, 14 May 1980)	
1	6:11314	*See* LBL-11690
CONF-8005137-	(International training course on nuclear materials accountability for safeguards purposes, Santa Fe, NM, USA, 27 May-6 Jun 1980)	
(Vol.1)	6:10399	*See* LA-8620-C(Vol.1)
(Vol.2)	6:10400	*See* LA-8620-C(Vol.2)
CONF-800611-	(International symposium on the management of alpha-contaminated wastes, Vienna, Austria, 2-6 Jun 1980)	
10	6:10369	*See* IAEA-SM-246/44
CONF-8006145-	(IMACS symposium on computer methods for PDE's, Bethlehem, PA, USA, 30 Jun-2 Jul 1980)	
1	6:11855	*See* UCRL-85293
CONF-8006151-	(Environmental Protection Agency conference, Washington, DC, USA, 14-17 Jun 1980)	
1	6:11661	*See* BNL-28789
CONF-800724-	(20. international conference on high energy physics, Madison, WI, USA, 17-23 Jul 1980)	
62	6:11770	*See* DOE/ER/70004-273
CONF-800778-	(18. course: the high energy limit, Erice, Trapani, Italy, 31 Jul-11 Aug 1980)	
3	6:11762	*See* BNL-28825
CONF-800780-	(46. National Society of Professional Engineers annual meeting, Detroit, MI, USA, 20-26 Jul 1980)	
(Vol.1)	6:11000	NTIS, PC A08/MF A01
(Vol.1)	6:11020	NTIS, PC A08/MF A01
(Vol.1)	6:11023	NTIS, PC A08/MF A01
(Vol.1)	6:11042	NTIS, PC A08/MF A01
(Vol.1)	6:11058	NTIS, PC A08/MF A01
(Vol.1)	6:11059	NTIS, PC A08/MF A01
(Vol.1)	6:11091	NTIS, PC A08/MF A01

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CONF-800782-		(SLAC/Summer Institute conference on the weak interaction, Menlo Park, CA, USA, 28 Jul-8 Aug 1980)
i	6:11751	*See* LBL-11844
CONF-800786-		(Symposium on the next steps in two-phase flow, Providence, RI, USA, 21-25 Jul 1980)
(Exec.Summ.)	6:10778	*See* DOE/ET/27225-12
CONF-800802-		(89. annual meeting of the American Institute of Chemical Engineers, Portland, OR, USA, 17-20 Aug 1980)
23	6:11186	NTIS, PC A02/MF A01
CONF-800814-		(180. American Chemical Society meeting/2. chemical congress of the North American Continent, Las Vegas, NV, USA, 24-29 Aug 1980)
31(Rev.)	6:10513	*See* LBL-11489(Rev.)
P2	6:10307	25: No. 3, 59-69(1980)
CONF-800869-		(Quadrennial international ozone symposium, Boulder, CO, USA, 4-9 Aug 1980)
5	6:11531	NTIS, PC A02/MF A01
CONF-800891-		(Conference on fleet use of unique automotive fuels, San Antonio, TX, USA, 13-14 Aug 1980)
	6:11259	NTIS, PC A10/MF A01
	6:11260	NTIS, PC A10/MF A01
	6:11261	NTIS, PC A10/MF A01
CONF-800932-		(2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas, Como, Italy, 3-12 Sep 1980)
7	6:11816	*See* COO-2218-189
CONF-8009108-		(Alternate sources of energy conference, New York, NY, USA, 29 Sep 1980)
	6:10425	NTIS, PC A08/MF A01
	6:10436	NTIS, PC A08/MF A01
	6:10459	NTIS, PC A08/MF A01
	6:10460	NTIS, PC A08/MF A01
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	6:10462	NTIS, PC A08/MF A01
	6:10476	NTIS, PC A08/MF A01
	6:10824	NTIS, PC A08/MF A01
	6:11037	NTIS, PC A08/MF A01
	6:11202	NTIS, PC A08/MF A01
	6:11237	NTIS, PC A08/MF A01
CONF-8009122-		(NCSL workshop and symposium, Gaithersburg, MD, USA, 22-25 Sep 1980)
1	6:11479	*See* BDX-613-2550
CONF-8009123-		(International symposium on biogas, microalgae, and livestock wastes, Taipei, Taiwan, 15-17 Sep 1980)
1	6:10477	NTIS, PC A03/MF A01
CONF-8009127-		(Mid-America solar update conference, Saint Paul, MN, USA, 9 Sep 1980)
1	6:10624	NTIS, PC A02/MF A01
2	6:10648	Minneapolis, MN; Mid-America Solar Energy Complex (1980).
CONF-8009130-		(International symposium on scanned image microscopy at the Royal Society, London, UK, 22-24 Sep 1980)
1	6:11299	*See* IS-M-308
CONF-801022-		(Flywheel technology symposium, Scottsdale, AZ, USA, 19-24 Oct 1980)
(Suppl.1)	6:10961	NTIS, PC A07/MF A01
(Suppl.1)	6:10962	NTIS, PC A07/MF A01
(Suppl.1)	6:10963	NTIS, PC A07/MF A01
(Suppl.1)	6:10964	NTIS, PC A07/MF A01
(Suppl.1)	6:10965	NTIS, PC A07/MF A01
(Suppl.1)	6:10966	NTIS, PC A07/MF A01
(Suppl.1)	6:10967	NTIS, PC A07/MF A01
(Suppl.1)	6:10968	NTIS, PC A07/MF A01
(Suppl.1)	6:11243	NTIS, PC A07/MF A01
(Suppl.1)	6:11244	NTIS, PC A07/MF A01
(Suppl.1)	6:11245	NTIS, PC A07/MF A01
CONF-8010139-		(Integrated county-level-data users workshop, Reston, VA, USA, 15-16 Oct 1980)
(Absts)	6:11861	NTIS, PC A04/MF A01
CONF-8010141-		(ICANS IV conference, Tsukuba, Japan, 20-24 Oct 1980)
1	6:11468	*See* LA-UR-80-2969
CONF-8010150-		(Conference on synthetic fuels: status and directions, San Francisco, CA, USA, 13-16 Oct 1980)
1	6:10156	Chicago, IL; Institute of Gas Technology (1980).
CONF-8010151-		(Inhalation chamber technology conference, Upton, NY, USA, 16-17 Oct 1980)
1	6:11687	*See* BNL-28749
CONF-8010155-		(Colloquia on chemical evolution, colloquium V, comets and the origin of life, College Park, MD, USA, 29-31 Oct 1980)
1	6:11716	*See* LA-UR-80-3474
CONF-8010157-		(Symposium on nondestructive evaluation, Pittsburgh, PA, USA, 20-23 Oct 1980)
1	6:11809	*See* BNL-28795
CONF-801102-		(ASME winter annual meeting, Chicago, IL, USA, 16-21 Nov 1980)
33	6:11436	Chicago, IL; Inst. of Gas Tech. (1980).
CONF-801104-		(73. annual meeting of the American Institute of Chemical Engineers, Chicago, IL, USA, 12-16 Nov 1980)
12	6:10157	Chicago, IL; Institute of Gas Technology (1980).
CONF-801107-		(ANS international conference, Washington, DC, USA, 17-21 Nov 1980)
60	6:10363	NTIS, PC A03/MF A01
62	6:10932	*See* DP-MS-80-76
CONF-801126-		(ORSA/TIMS joint national meeting, Colorado Springs, CO, USA, 9-12 Nov 1980)
2	6:11067	*See* BNL-28745
CONF-801137-		(Workshop on energy policy analysis, Urbino, Italy, 3 Nov 1980)
2	6:11068	*See* BNL-28839
CONF-801151-		(6. photovoltaic concentrator technology development project intergration meeting, Albuquerque, NM, USA, 5-6 Nov 1980)
	6:10520	*See* SAND-80-2373
CONF-801152-		(Electric Power Research Institute workshop, Atlanta, GA, USA, 17-19 Nov 1980)
2	6:11185	*See* BNL-28838
CONF-801171-		(7. national conference on energy and the environment, Phoenix, AZ, USA, 30 Nov-3 Dec 1980)
2	6:10510	*See* DP-MS-80-116
3	6:11184	*See* BNL-28837
CONF-801173-		(DOE advanced environmental control technology program conference, Morgantown, WV, USA, 6-7 Nov 1980)
1	6:11315	*See* LBL-11800
CONF-801201-		(3. international conference on lasers and applications, New Orleans, LA, USA, 15-19 Dec 1980)
6	6:11840	*See* LA-UR-81-94
7	6:11429	*See* LA-UR-81-15
8	6:11417	*See* LA-UR-81-145
9	6:11418	*See* LA-UR-81-150
10	6:11422	*See* SAND-81-0218C
CONF-801203-		(National conference on renewable energy technologies, Honolulu, HI, USA, 7-13 Dec 1980)
5	6:10634	*See* SAND-80-1869C
CONF-801209-		(2. annual National Waste Terminal Storage (NWTS) information meeting, Columbus, OH, USA, 9-11 Dec 1980)
7	6:10385	*See* SAND-80-2190C
CONF-801213-		(Local alternative energy futures-developing economy building communities conference, Austin, TX, USA, 11-13 Dec 1980)
(Prelim.)	6:11010	NTIS, PC A19/MF A01
(Prelim.)	6:11043	NTIS, PC A19/MF A01
(Prelim.)	6:11044	NTIS, PC A19/MF A01
(Prelim.)	6:11045	NTIS, PC A19/MF A01
CONF-801227-		(Atomic and nuclear methods in fossil energy research meeting, Mayaguez, Puerto Rico, 1-4 Dec 1980)
3	6:11300	*See* BNL-28668
CONF-801235-		(Workshop on uncertainty in uranium resource and cost assessments, Denver, CO, USA, 8-9 Dec 1980)
1	6:10320	*See* K/CSD/INF-80/41
CONF-801237-		(Meeting on electrical insulators for fusion magnets, Germantown, MD, USA, 15 Dec 1980)
1	6:11832	*See* LA-UR-80-3579
CONF-801238-		(EXXON conference on surface science, Linden, NJ, USA, 4-5 Dec 1980)
1	6:11742	*See* LBL-11720
CONF-801241-		(1. workshop on NDE of titanium alloys, Orlando, FL, USA, 9-10 Dec 1980)
1	6:11437	*See* LA-UR-81-227
CONF-801242-		(Electric and hybrid vehicle advanced technology seminar, Pasadena, CA, USA, 8-9 Dec 1980)
1	6:11133	*See* LA-UR-81-293
CONF-801244-		(Workshop on weak interactions as probes of unification, Blacksburg, VA, USA, 3-6 Dec 1980)
1	6:11774	*See* BNL-28876

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CONF-810105-		(International geothermal drilling and completions technology conference, Albuquerque, NM, USA, 21-23 Jan 1981)
3	6:10779	*See* LA-UR-81-26
4	6:10781	*See* SAND-80-1704C
5	6:10782	*See* SAND-80-2702C
CONF-810110-		(National low level waste management information meeting, San Diego, CA, USA, 6-7 Jan 1981)
1	6:10382	*See* RFP-3181
CONF-810111-		(Annual meeting of the Transportation Research Board, Washington, DC, USA, 12-16 Jan 1981)
1	6:11171	NTIS, PC A03/MF A01
CONF-810112-		(Urethane foam expo-6 conference, Orlando, FL, USA, Jan 1981)
1	6:10370	*See* MLM-2797(OP)
CONF-810113-		(Simulation methods for nuclear power systems conference, Tucson, AZ, USA, Jan 1981)
1	6:11846	*See* LA-UR-81-270
2	6:10940	*See* LA-UR-81-237
CONF-810115-		(Nuclear and particle physics at energies up to 31 GeV: new and future aspects conference, Los Alamos, NM, USA, Jan 1981)
2	6:11788	*See* LA-UR-81-206
CONF-810118-		(Army research office workshop on repetitive opening switches, Durango, CA, USA, 29-30 Jan 1981)
1	6:11833	*See* LA-UR-81-269
CONF-810119-		(19. international winter meeting on nuclear physics, Bormio, Italy, Jan 1981)
1	6:11793	*See* LA-UR-81-301
CONF-810120-		(Workshop on the impact of hydrogen on water reactor safety, Albuquerque, NM, USA, 26-28 Jan 1981)
1	6:10949	*See* UCRL-84164
CONF-810207-		(SPE economics and evaluation symposium, Dallas, TX, USA, 25-27 Feb 1981)
1	6:11019	*See* SPE-9553
CONF-810208-		(Executive conference - state, federal nuclear interface, Monterey, CA, USA, 2 Feb 1981)
1	6:10365	*See* DPSP-AFR-80-6-3
CONF-810209-		(Interpipe conference, Houston, TX, USA, 24 Feb 1981)
1	6:10898	*See* GEFR-SP-230(SP)
CONF-810210-		(2. Australian thermodynamics conference, Melbourne, Australia, 15-19 Feb 1981)
1	6:11317	*See* UCRL-85232
CONF-810211-		(American Society of Photogrammetry and the American Congress on Surveying and Mapping convention, Washington, DC, USA, 22-27 Feb 1981)
1	6:11471	*See* LBL-12006
CONF-810212-		(US/Japan joint workshop on compact toroids, Osaka, Japan, Feb 1981)
1	6:11820	*See* LA-UR-81-304
2	6:11834	*See* LA-UR-81-325
CONF-810213-		(11. annual computer output microfilm technology conference, Lincolnshire, IL, USA, Feb 1981)
1	6:11847	*See* LA-UR-81-284
CONF-810214-		(4. topical conference on radio frequency plasma heating, Austin, TX, USA, 9-10 Feb 1981)
1	6:11819	*See* DOE/ET/53051-16
2	6:11818	*See* DOE/ET/53051-15
CONF-810309-		(ASME gas turbine conference, Houston, TX, USA, 9-12 Mar 1981)
7	6:10894	*See* GA-A-16016
CONF-810311-		(2. international conference and exhibition on engineering software, London, UK, 24-26 Mar 1981)
1	6:11845	*See* LA-UR-80-3502
CONF-810312-		(International conference on excited states and multiresonance nonlinear optical process in solids, Modane, France, 18-20 Mar 1981)
1	6:11811	*See* LA-UR-80-3528
CONF-810313-		(American Society of Microbiology meeting, Dallas, TX, USA, 3-6 Mar 1981)
1	6:11625	*See* DP-MS-80-107
CONF-810401-		(Structures, structural dynamics and materials conference, Atlanta, GA, USA, Apr 1981)
2	6:11218	*See* DOE/NASA/1028-29
CONF-810405-		(3. annual systems simulation, economic analysis/ solar heating and cooling operational results conference, Reno, NV, USA, 27 Apr-1 May 1981)
6	6:11153	*See* SERI/TP-721-1008
7	6:10443	*See* SERI/TR-721-960

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CONF-810412-		(International conference on recent advances in geotechnical earthquake and soil dynamics, St Louis, MO, USA, 26 Apr-2 May 1981)
1	6:11697	*See* SAND-80-2718C
2	6:11704	*See* SAND-80-2719C
3	6:11703	*See* SAND-80-2655C
CONF-810413-		(ICASSP '81, Atlanta, GA, USA, 1 Apr 1981)
1	6:11698	*See* UCRL-85330
CONF-810414-		(Reliabililty conference for the electric power industry, Portland, OR, USA, 21-23 Apr 1981)
1	6:11080	*See* UCRL-84162
CONF-810415-		(ANS/ENS joint topical meeting on mathematical methods in nuclear engineering, Munich, F.R. Germany, 27-29 Apr 1981)
1	6:11801	*See* LA-UR-81-100
3	6:11802	*See* LA-UR-81-101
CONF-810416-		(IEEE region 6 conference on electrical engineering applications in the pacific, Honolulu, HI, USA, 1-3 Apr 1981)
1	6:11841	*See* LA-UR-81-82
CONF-810417-		(90. AICHE national meeting, Houston, TX, USA, 5-9 Apr 1981)
1	6:10139	*See* SAND-80-1526C
CONF-810418-		(Military space doctrine symposium, Colorado Springs, CO, USA, 1-3 Apr 1981)
1	6:11842	*See* LA-UR-81-192
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34010-1	6:10887	NTIS, PC A03/MF A01
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81-001-1	6:10188	*See* DOE/EV/73002-1(Vol.1)
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81-001-3(Vol.3)	6:10432	*See* DOE/EV/73002-1(Vol.3)
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Abbreviations Used in Availability Column

Dep. DOE reports so designated are maintained in the organizations listed on the inside back cover.

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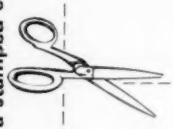

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